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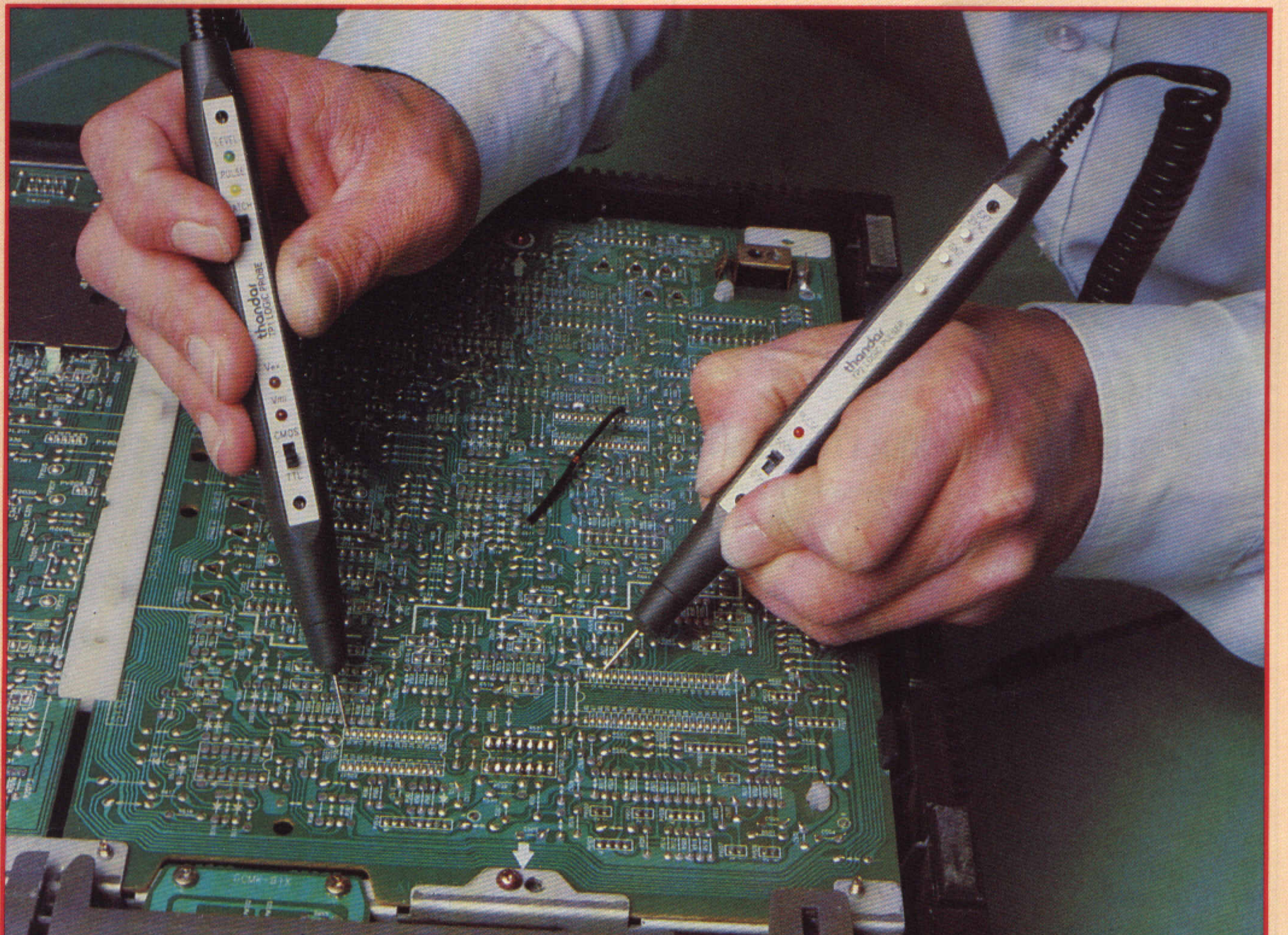

Servicing with a Logic Probe and Pulser

Cable Television Techniques

Budget Variable PSU • DX-TV

VCR Clinic • TV Fault Finding

TELEVISION

August
1987

Vol. 37, No. 10
Issue 442

On sale July 15th

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QUERIES

We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television,* but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. Correspondents should enclose a stamped addressed envelope.
Requests for advice on dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Service Bureau". Send to the address given above (see "correspondence").

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TELEVISION

EDITOR

John A. Reddihough

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COVER PHOTO

Our cover photo this month shows a logic probe and pulser being used in the investigation of a problem with a syscon panel in a Fisher VCR. The probe and pulser are the Thandar TP1 and TP2 respectively. They are available from B.K. Electronics of Southend-on-Sea – see advertisement elsewhere in this issue.

CORRECTIONS

Our apologies for mislettering Fig. 38(a) on page 613 last month. D0, D1, D3, D4 should have been shown as D0, D1, D2, D3.

It would appear that the source and gate two leadout connections were shown reversed in Fig. 1, page 384 of the April issue. We are investigating this: the BF960 and BF961 appear to have different encapsulations.

End of an Era

We tend to think of Ferguson as a major TV manufacturer. It has, after all, been the largest supplier of TV sets to the UK market for many years. But today TV manufacture has to be considered in a global context, and looked at in this respect Ferguson no longer appears as a major force. Thorn EMI's decision to sell its Ferguson manufacturing subsidiary to the French Thomson group is probably the right one, though it's nevertheless sad that such an established and respected manufacturer should pass from UK control. Under its new owners Ferguson will be part of a group producing over three million sets a year. This is still well below the annual colour TV receiver output of the two world giants in the industry, Philips and Matsushita, but it does place the group amongst the ranks of major manufacturers such as Sony, Hitachi and Toshiba.

Last year Ferguson produced some 680,000 TV receivers. Output is at present running at a rate in excess of one million a year. But only a small proportion of this is exported – some ten per cent. Ferguson designs, the famous TX series, are technically excellent and economical to produce. Thorn has invested over £30m during the last two years in modernising the Ferguson plants, but this still hasn't added up to profitability. Ferguson had a bad year in 1984-5 when it made a loss of £25m. The following year saw a return to a small profit but recently, following further price cutting in the UK TV market, it has slid back into losses. Thorn must have wondered when and if it was ever likely to see any profit in consumer electronics manufacturing. It was faced with the need for further investment to increase production capacity but came to the conclusion that it could deploy the resources available to it more profitably elsewhere. One can understand the hard decision that faced Thorn. It nevertheless seems to have been taken fairly hastily, and came as a surprise to the industry. Thorn made an approach to Thomson in the belief that Ferguson should be part of a major European consumer electronics group. It had been forging closer links with Thomson in recent years. The situation was expressed by Thorn director Dr. Jim Maxmin in the following words: "during the last year we came to understand that however efficient we became, if we didn't have overseas markets would couldn't compete".

The merger still leaves the group dependent mainly on the European market, which is a saturated one relying largely on replacement and first-time homemaker sales and rentals. One can't help speculating on whether a merger with JVC, with whom Ferguson also has close ties – the Gosport plant is now producing a JVC designed chassis to meet JVC's European sales requirements – would not have been more appropriate. Maybe Thorn feared the political row that might have ensued, and maybe it felt that Ferguson would retain a greater degree of independence in linking up with Thomson. Whatever the reason, the decision is still a curious one. Thomson may be big, but has not been all that successful in the past in the consumer electronics field. The state-owned company has relied on considerable government support in modernising its operations. It's now on the government's privatisation list. Will it find fund raising all that easy once in the private sector? Seen in this light the link with Ferguson is certainly a favourable development.

The departure of Ferguson from UK control leaves very little of the industry in UK hands, though the UK remains a substantial base for TV manufacture. Matsushita (Panasonic), Sony, Mitsubishi, Hitachi, Toshiba, Sanyo and Tatung all operate plants in the UK. Only Fidelity, whose output has in recent times increased to over 250,000 sets a year, remains in UK ownership, though Fidelity's parent company has made no secret of its hope of hiving off Fidelity as part of a joint venture.

The sad thing in all this is how much design and research capacity, if any, will remain in the UK? Just over a year after celebrating the start of TV broadcasting in the UK fifty years ago we suddenly find ourselves with an industry almost entirely in foreign hands. It's a long time since design teams in thirty or so companies were working on TV. But design has for many years been moving from the setmaker to the component manufacturer. Even thirty years ago Mullard was supplying valves along with the circuit designs for their use, and setmakers were adapting these to suit their purposes. Mullard and others extended this to the production of complete receiver designs which formed the basis of what many setmakers went on to manufacture. Ferguson at least maintained a healthy independence throughout, with individualistic designs and a philosophy of looking and planning well ahead. But as more and more circuitry disappeared into a handful of chips setmakers' research and development work became more and more a matter of checking on component parameters, compatibility and long-term reliability. This is vital work of course, but it's not like starting on a TV chassis from scratch!

In retrospect, one should have seen the end of TV as a major indigenous UK industry long ago. In the immediate post-war era the UK was isolated by its unique 405-line system. No one else was interested in producing 405-line sets and UK manufacturers were reluctant to develop sets for other standards. The collapse started with the use of a common European standard (with minor variants). When the Japanese started to enter the TV field they thought in terms of world-wide markets. This meant designs that with little alteration could be sold anywhere, and guaranteed out of the carton reliability. UK manufacturers subsequently achieved similar standards of performance and reliability, but by that time the Japanese had come to dominate the international market for TV equipment.

Long-distance Television

Roger Bunney

The month of May proved to be a spectacular one for Sporadic E reception. Signals were received from most of Europe and there were several exotics from Africa. Tropospheric reception was encouraging, with several periods of enhanced propagation in Bands I, III and at u.h.f. The SpE log for the month, particularly from the third week onwards, resembles a Band I station list for Europe!

6/6/87 TVE (Spain) ch. E3.
7/5/87 ARD (West Germany) E2, 3; TVP (Poland) R2; CST (Czechoslovakia) R2; TSS (USSR) R2.
8/5/87 TVE E2, 3, 4; +PTT (Switzerland) E2, 3; NRK (Norway) E2, 3, 4; SR (Sweden) E2; NTV Sokoto (Nigeria) E3.
9/5/87 TSS R1, 2; MTV (Hungary) R1, 2; TVR (Rumania) R2; TVP R1; ARD E2; JRT (Yugoslavia) E3, 4; TVE E2, 3, 4; RTP (Portugal) E2, 3.
10/5/87 NRK E2.
14/5/87 TVE E3.
16/5/87 TVE E3.
17/5/87 TVE E2, 3; RTP E2, 3; RAI (Italy) IA, B; RETE A (Italy) E3; JRT E3, 4; ARD E2; CST R2; MTV R1; +PTT E3.
18/5/87 TVE E2, 3, 4; TVE-2 E2; RTP E2, 3; RAI IA; JRT E3; ARD E2; MTV R1; TVP R1, 2; TSS R1, 2, 3; CST R1; RUV (Iceland) E4; Canal Plus (France) L3; RTT (Tunisia) E4; Arabic "wailing" E3, unidentified; DR (Denmark) E3.
19/5/87 TVE E2, 3; TVE-2 E2; RTP R3; RAI IA, B; CST R1; JRT E3; TSS R1; ORF (Austria) E3; YLE (Finland) E3, 4; RUV E4.
20/5/87 TVR R2; JRT E3, 4; CST R1; TVP R1; RAI IA; TVA Canale A (Italy) E3; TSS R1, 2; NRK E2, 3, 4; SR E2, 3; JTV (Jordan) E3.
21/5/87 TSS R2.
22/5/87 TVE E2, 3; RTP E3; NRK E2; CST R2; TSS R1, 2.
23/5/87 TVE E2, 3; TVE-2 E2; RTP E2, 3; RAI IA, B; MTV R1, 2; NRK E2, 3; TVR R2; ARD E2, 3; JRT E3, 4; TSS R1, 2; RUV E4; RTT E4; RTM (Morocco) E4 – seen as floater over RTT at 1600-1700BST!
24/5/87 RUV E4.
25/5/87 TVE E2, 3, 4; TVE-2 E2; RTP E2, 3; RAI IA, B; +PTT E2; Canal Plus L3.
26/5/87 TVE E3; NRK E3; DFF (East Germany) E4.
27/5/87 TVE E2, 3, 4; TSS R1; RTP E3.
28/5/87 TVE E2, 3, 4; TVE-2 E2; RAI IA, B; ORF E2a, 4; JRT E3, 4; MTV R1, 2; TVE R2; ARD E4; CST R1, 2; DFF E4; Canal + L3; SR E2, 3, 4; NRK E2, 3; RUV E4; YLE E3; NCT (Italy) IA. Arab Band II f.m. stations were also noted. There was blanket SpE throughout Band I with m.u.f.s reaching 150MHz.
29/5/87 TVE E2, 3, 4; RTP E3; RAI IA; ORF E2a; JRT E3, 4; TVR R2; TVP R1; CST R1, 2; TSS R1, 2, 3, 4, 5; DFF E4; NRK E2, 3, 4; SR E2, 3, 4; RUV E4; DR E31; RTB-F Belgium from Liege on ch.E3 was noted via very short skip SpE at Torpoint, East Cornwall. Blanket SpE was experienced during part of the day.
30/5/87 TVE-2 E2; TVE E3, 4.
31/5/87 TVE E2, 3, 4; RAI IA.
1/6/87 NRK E2; TSS R2.

An excellent period then, made more interesting by the evidence of ch. E4 outlets in Morocco and Tunisia. NTV Sokoto ch. E3 was logged in Hastings and St. Leonards on May 8th, with programmes from 1945-2030 BST preceded by the test pattern and opening routine. TVE had been in at the same time. Poland TVP-1 was seen using an electronic test pattern not unlike the Channel 4 one, with the identification "TVP-1" across the bottom. Signals were received from several Italian "free" stations during the month, including RETE A on ch. E3 (not IA) and TVA on ch. E3 (though the caption indicated ch. IA!). Spanish TVE-2 signals were received in chs. E3 and 4. This turned out to be material from the TVE-2 centre in Madrid being carried over the TVE-1 network – so take care! NOS (Holland) has on occasion been seen transmitting BRT (Belgium) programmes: at such times the identification "BRT" is present at the top left-hand corner. The Russian 0167 electronic pattern has been seen on ch. R1 with the identification "NTR" – any ideas? Another query comes from Bill Cotterill who noted the caption "T.S. TELSUR" on ch. E4 soon after receiving RUV on this channel. Help needed in identifying this!

There was tropospheric propagation over the period May 7-9th when many W. German, Belgian, Dutch and French Band III/u.h.f. stations, also RTL (Luxembourg), were received over much of central/south England. More productive of signals was the spell during the 22nd-26th, particularly in the east/north of England and Scotland, again with signals from W. Germany, Belgium, Holland and Luxembourg, plus DR (Denmark) and Scandinavia. NRK chs. E3 and 4 were received in Aberdeen on the 22nd but later in the period reception shifted more to the south. Ray Davies had an interesting catch when he received the Dutch pirate "Orion TV Kanal 34", i.e. ch. E34. The signal came from Alkmaar and consisted of captions and a film. Time was 1950-2200 BST. We're checking on power output etc. since this is the most distant report so far of such a pirate station.

My thanks to the following for reports on their reception: Iain Menzies (Aberdeen), Bill Cotterill (Tipton), Roger Fussell (Torpoint), Simon Hamer (Powys), Tim Anderson (St. Leonards), Dave Shirley (Hastings), Cyril Willis (Norfolk), David Martin (Poole) and David Philpott (Polperro).

A letter arrived from Hugh Cocks during the month reporting on his reception in Portugal. He mentions that on most days Ghana ch. E2 is received from 1845-2000 BST. A FUBK type colour pattern is now being used instead of a grey-scale pattern. Programmes start at 1900 weekdays, earlier at the weekends. On April 17th Hugh logged a System M (525 lines) signal on ch. A2, with VITS on the nominal 55·24MHz carrier. There was good picture quality but no sound. Reception was from the south west, suspected as being from south/central America.

News Items

France: A ch. E53 transmitter carries PTT Telecom-1 downlink material during the early mornings – its test pattern has the identification "Paris Poncelet". The direction suggests location in N.E. France in the approximate area of Dunkirk. Apparently the transmitter carries the M6 service later in the day.

East Germany: It has been announced that the Cottbus ch. E4 transmitter, which carries the DFF-1 service, is to be closed down and the v.h.f. mast demolished. DFF-1 will be moved to ch. E53 along with DFF-2 on ch. E23 – e.r.p. 1,000kW in each case.

Denmark: The TV-2 transmitter network is to be as follows: Thisted ch. 28, Aalborg ch. 35, Lolland ch. 52, Fyn ch. 22, Kobenhavn ch. 53, Svendborg ch. 32, Sydsjaelland ch. 50, Aarhus ch. 26, Kalundborg ch. 48, Sonderjylland ch. 27, Vendsyssel ch. 37, Sydvestjylland ch. 33, Vejle ch. 30, Vestjylland ch. 40, Viborg ch. 54. No powers have so far been announced.

Holland: Gosta van der Linden noted two-channel sound from Lopik-2 recently on ch. E27, with Radio-1 left and Radio-5 right. Tests are due soon from Lipik-3 on ch. E30.

Poland: A transmitter has been commissioned to carry the Czechoslovakian CST-1 service in Warsaw on ch. R51 (e.r.p. 20kW).

Satellite TV: A treaty on the W. German DBS services has been signed in Bonn. Of the four channels one will be operated by ARD, another by ZDF and the other two will be run by private companies. The three beams will cover the country as follows: north beam Lower Saxony, Bremen, Hamburg and Schleswig Holstein; west beam Hessen, North Rhine-Westphalia; south beam Baden-Wurttemburg and Bavaria. The north beam will cover West Berlin.

The MTV-Europe pop music service via the 27·5°W Intelsat bird should start this month, using a full east spot transponder. The BT-SRS horse racing service from this satellite is now scrambled using BMAC.

It's likely that a second Astra satellite will be launched some eighteen months after the first, into an adjacent orbital spot, thus providing a total of 32 channels from this direction.

Aerial Update

Details of an East European aerial with helical wound elements were included in this column last month. It had a seemingly very high gain considering the bandwidth and the compact size of the array. Igor Hajek, who is well versed in East European languages, has since looked through the original material. He comments that the initial article on the aerial was actually written in Bulgarian and published in a Bulgarian hobbyist magazine. It was subsequently edited and published in a Russian magazine. It created considerable interest and both magazines followed up with material answering readers' questions. The aerial covers 48·5-230MHz with a gain of 10dB over the entire bandwidth. Its design is based on "spiral-dielectric vibrators", the construction using glass/plexi for the elements, boom etc. Suggestions for alternative material include glass textolite/vinidur.

Tests of the Les Wallen short base aerials for SpE reception in Band I continue. Some remarkable results were noted during the recent good SpE periods. A previously mentioned source of interference at 49MHz (the Golden Eagle baby alarm), which is about half a mile from my location, is strongly received by the 27MHz aerial. Output from the 49MHz aerial is 8-10dB down in comparison. With short/medium hop Band I SpE signals the 49MHz aerial produces noticeably greater output than the 27MHz version. This was rather unexpected. The shorter skip (i.e. from a distance of 500-800 miles) signals tend to suffer greater polarisation shift than those from farther afield. With shorter skip signals the vertical aerials provide better results than a standard four-element, full-size horizontal Band I Yagi array. With more distant SpE signals, such as those from the USSR, the Yagi array gave the best results. Both the vertical aerials had poor performance with such long hop signals.

The response of the 27MHz aerial is substantially level with respect to ground but the response of the 49MHz aerial increases with signals coming from an upwards direction, i.e. it favours short-skip SpE signals that arrive from a steeper angle. This observation is confirmed by the previously mentioned fact that the 49MHz aerial had poorer response to the local interference signal. A horizontal "dipole" consisting of two 27MHz aerials with signal combining via a low-loss transformer is being constructed and will be mounted at about 40ft, adjacent to the vertical aerials, to assess its performance with more distant signals. The 19in. 49MHz Les Wallen paging aerial certainly gave encouraging results during the recent good SpE conditions. Experiments with these aerials continue.

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6m Amateur Band

From June 1st both Class A and Class B radio amateur licence holders are allowed full-time use of the 50MHz amateur band, using all modes of transmission. There is a suggestion that higher output powers may subsequently be allowed. 50-51MHz is for primary users and 51-52MHz for secondary users, i.e. sole and shared use respectively. The 70-70·5MHz band has also been allocated to amateur use, for secondary users. The e.r.p. output at 50MHz must not exceed 14dBW carrier and 20dBW sideband, taking into account aerial gain and feeder losses. Most important is that interference is not caused to other countries' services. Mobile operation is not permitted and the aerial height must not exceed 20m a.g.l. The aerials must be horizontal.

Several European countries now allow a restricted form of 50MHz amateur radio operation on an experimental basis, namely Gibraltar, Greenland, Eire, Portugal, Norway, Iceland and Spain. Countries considering 50MHz

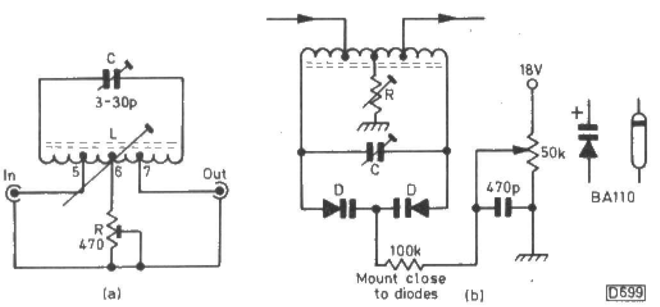


Fig. 1: (a) Traditional Band I notch filter. L consists of 11 turns of 24-28g enamelled wire on a ¼in. former, wound over ¾in. and tapped at 5, 6 and 7 turns, with dust core. The potentiometer is a subminiature preset and the trimmer a miniature type. (b) Varicap tuned version.

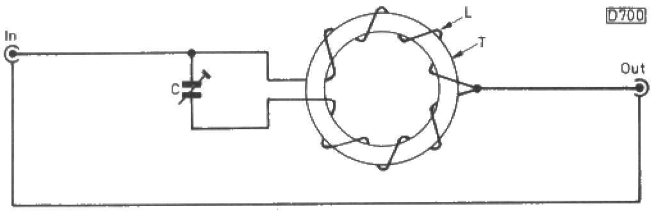


Fig. 2: Simpler notch filter using a ferrite toroid (Cirkit type T50-12). L consists of 11 turns of 24-28g enamelled wire tapped at turn 5·5. C is 3-30pF.

amateur operation include Cyprus, W. Germany, Malta and Yugoslavia. The 50MHz band is extensively used for amateur radio operation in other parts of the world – the allocation in the USA is 50-54MHz.

There is naturally great interest in amateur radio circles, since given appropriate SpE/F2 conditions and the much narrower bandwidths than those used for TV very distant weak signals can be resolved – long before a TV-DXer could resolve even a vague image from the same area on an adjacent channel. So it's likely that the UK 50MHz band will become very active during the SpE season. With the considerable radio amateur population in the UK and the congestion in the 144MHz band it's quite likely that many Class B operators will move to 50MHz.

Up to the end of May 50MHz amateur operation has not given TV-DXers too many problems, but from now on we must expect interference in chs. E2, R1 and IA. Since amateur radio operation is restricted to horizontal polarisation a useful reduction in such interference should be achieved by using a vertical aerial system. This will also improve short/medium distance SpE reception due to the polarisation shifts that occur. Use of a narrow i.f. bandwidth within the TV receiver, a technique long advocated in this column for weak signal reception, should also help to minimise interference.

We don't at present have a design for a suitable bandstop filter, and it's unlikely that one could be designed with a notch at 50MHz while still allowing reception of the ch. R1 carrier at 49·75MHz. Sharp attenuation over the 50-52MHz band with a steeply sided characteristic and nominal loss outside the band would be a remarkable filter indeed! Since the 50-50·1MHz part of the band is for beacon use only, with s.s.b. activity starting at 50·1MHz upwards, I feel that a short-term solution would be to use a notch filter tuned to approximately 50·4MHz. This should give reasonable attenuation over the 50·1-50·7MHz segment. An alternative would be a varicap tuned notch filter with switched positions for various parts of the band so that notches can be selected to minimise the problem when interference occurs. An alternative would be a fine-tune carbon potentiometer to sweep across the 2MHz segment.

The notch filter circuits in Figs. 1 and 2 have been shown before but are included this time in view of the problems that are now likely to confront us. They are simple but effective designs. Both cover Band I and with the values given provide a notch depth of 24dB. The design shown in Fig. 1(a) is a bit more complicated: the windings should be held in place with glue or varnish. The filter is tuned with the core, the preset potentiometer peaks the notch and enables an extremely sharp characteristic to be achieved in conjunction with the tuning capacitor. Varicap diodes can be used in place of the latter, as shown in Fig. 1(b). Fig. 2 shows a simpler filter using a toroid that's available from Cirkit.

An alternative filter might consist of a stub tuned to say 51MHz. This would remove much of the band, providing attenuation of around 25dB. Either an open-circuit quarter-wave or short-circuit half-wave stub can be used. Experiments along these lines are being conducted and I'll report back in due course. Meanwhile if any other TV-DXers would care to comment on the problem or provide suggestions for filters we'd like to hear from them.

Two-channel Sound

Stereo sound transmissions are now an established part of the W. German TV network and NOS (Holland) is carrying out experimental transmissions. Japan started two-channel sound transmissions, using an f.m./f.m. audio multiplex system, in 1978 – there's a main and a subchannel and a further control signal to denote either stereo or twin mono channels, the latter for bilingual programming for example. The W. German two-channel system started in the summer of 1981, using the standard 5·5MHz carrier (relative to the vision carrier) and a second carrier at 5·742MHz. The system developed by the BBC and accepted for UK terrestrial use has a second digitally-modulated carrier at 6·55MHz. This is in addition to the standard 6MHz f.m. sound carrier of course. The second carrier can provide sufficient information for either stereo or two-channel (e.g. bilingual) sound. The USA uses another system, a single sound carrier with pilot tone insertion of stereo or second channel information. The MAC system to be used for DBS TV broadcasting allows for two (or more) sound channels in yet other ways.

The BBC has been transmitting stereo sound on a test basis for some time. Unfortunately no circuit details that would allow a decoder to be built have been released. If any reader has a circuit or other information that would enable a decoder to be designed and built we'd naturally like to hear from him/her! When they become available commercial designs will doubtless use special-purpose chips.

For diposal

A reader in the Bournemouth area has several items for disposal to good homes. Apart from a Heathkit wobbulator, factory aligned and new for £25, the rest are free. There are two 19in. Ultra 800 series chassis 405/625-line TV sets, one modified for DX use; various Thorn 850 chassis spares; a Philips G6 chassis with valved line output stage and another with a tripler; a 22in. Bush set with the A823 chassis, varicap tuner version, with various spares; *Television* magazines from 1967-1986; and a car cartridge player plus two speakers. Items will have to be collected. If interested, write in with s.a.e. and we'll pass this on to the reader.

The 8mm Video System

Part 5

Eugene Trundle

Because, unlike the f.m. audio, the PCM audio occupies a totally different area of the tape from the vision signal it's possible to dub the PCM track without upsetting the picture. The existing PCM track is erased by feeding a suitably timed burst of energy to the flying erase head. The new PCM track is then laid down on the next video head pass. During this time the ATF servo is in the playback mode in order to maintain correct tracking and ensure that the dubbed PCM section is correctly aligned with the appropriate video track.

While the flying erase head is energised during the dubbing process the very strong magnetic field in the rotary transformer leaks into the signal sections, causing interference to the playback picture – the PCM period for one head coincides with a picture-read period of the other head. To conceal this, a masking signal is generated and used to mute the vision playback channel during the relevant period. This is the job of IC111 (see Fig. 36). The effect seen on the monitor during an audio dub is a complete masking of the bottom section of the picture plus, in the SP mode, a flickering bar about half way up the screen. The material recorded on the tape is not affected however and the picture is reproduced fully during subsequent, normal playbacks.

Multi-PCM

As we've seen, the whole of a stereo sound programme can be compressed into just 30° of each video head's rotation. If the tape is to be used entirely for hi-fi sound six such segments will occupy the length of each helical track. This is referred to as the multi-PCM mode, which permits six passes of the tape through the machine with a different segment (and hence stereo programme) being recorded or played back each time. Thus the total potential playing time for one P-60 cassette in the SP mode is 6 × 90 minutes = nine hours, or 6 × 180 minutes = 18 hours in the LP mode. Provision is included in the ATF servo system previously described for reverse PCM reading, so that the recording and playback can be continuous in either mode with the machine auto-reversing at each tape end.

For multi-PCM each helical track is divided into six equal segments of 36° each, including a guard band of about 6° between segments – the track layout is shown in Fig. 40. It should be borne in mind that the segments are unlikely to be aligned in a "straight queue" as shown here: each segment is recorded at a different time by a pair of heads whose path has no particular relationship to existing segments, and which may be writing SP or LP tracks. In other respects the data-on-tape format is identical to that used for PCM sound plus video. Each of the 36° segments has a data section of about 30°, with 26·3° of sound data prefixed and suffixed by 2·06° clock run-in and run-out periods.

An additional pilot signal at about 230kHz is continuously generated and added to the PCM sound signal during a multi-PCM recording. In the playback mode this signal is picked up by the ch. 2 and ch. 1′ heads which are both in contact with the tape at the same time. It's used to indicate which of the segments have been used to make a recording. With each recorded segment one of the heads provides a small output and the other a large output. These are combined to provide pulses while each "full" segment is being scanned. After processing the pulses are used to light up the section of the fluorescent "segment-exist" indicator on the front panel.

PCM Adaptors

As a very high quality alternative to analogue audio recording on reel-to-reel or cassette tape PCM got here before the Video-8 format. Several years ago Sony produced the PCM-F1 digital audio encoder for use with the SLF1 VCR – or others, including VHS machines. The PCM-F1 produces a PCM signal for application to the machine's video input terminal: so far as the VCR is concerned the input data looks like a baseband video signal, complete with line and field sync pulses, so that the entire tape area becomes occupied with PCM signal to the exclusion of any video signal. The system became very popular with professional sound recordists and was used to excellent effect for audio mastering, its only limitation being the two-channel capability. For mastering CD recordings a digital original is essential.

A PCM adaptor, Model PCM-EV10, is available for use with suitably equipped Video-8 deck machines with f.m. audio facilities only, e.g. the Sony EVA300. This adaptor carries out all the processing required to a line or microphone signal and provides picture with PCM sound operation similar to that with the top-line deck machines such as the EVS600 and ECS700. It hooks up via a multi-pin socket at the rear of the EVA300.

Servicing Aspects

The main feature of the Video-8 format is miniaturisation, and full advantage is taken of the small cassette, head and deck to produce very compact equipment. The electrical components are also very small and are in positions and of shapes largely dictated by the machines and, where applicable, the optics. All the latest miniaturisation techniques are used: chip (surface mounted) components, double-sided PCBs, flexible PCBs, 64- and 80-pin chips and so on. To deal with them

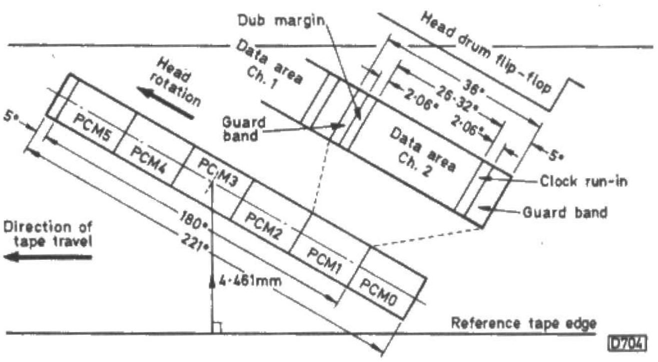


Fig. 40: Arrangement of recorded segments in the multi-PCM mode. Not all segments will necessarily be used, and those that are may be in the SP or LP mode. Each segment represents a different pass of the tape through the deck.

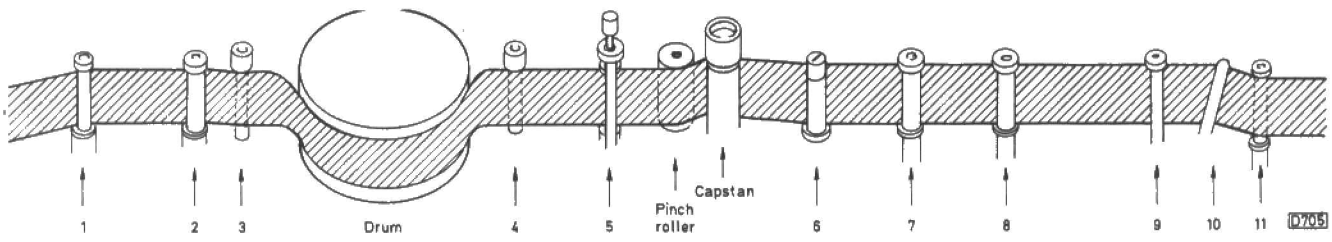


Fig. 41: Linear presentation of the Video-8 tape path. Guide functions and alignment are described in the text.

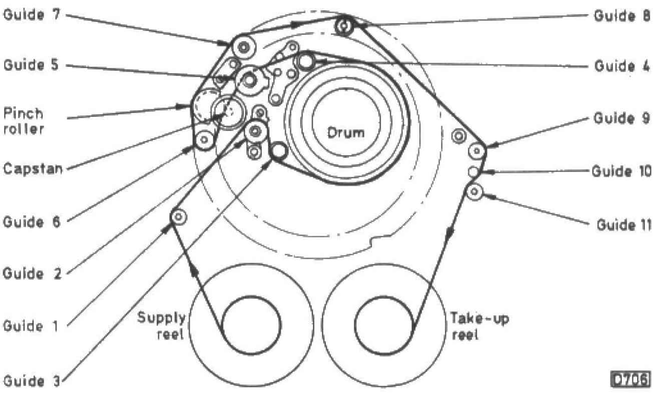


Fig. 42: Plan view of the main deck components and the tape route around them. Guides 1, 6 and 10 are responsible for tape threading, followed by guides 7 and 8 on the loading ring.

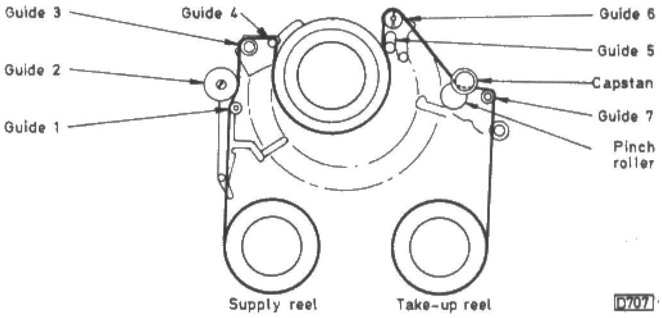


Fig. 43: The familiar-looking tape path in the compact Video-8 camcorder Model CCD-M8E.

you need a small, hot soldering iron, a good set of test equipment with small probes, and an ability (so far as is possible!) to diagnose faulty components in situ – in most cases substitution tests are not really practical.

Here's a tip, passed on to me by a fellow reader, for removing multi-legged chip components intact. First remove as much solder as possible with desoldering braid and a hot, small iron. Next pass a length of 5A fuse wire under all the legs and anchor it by soldering at the far end. Pull the free end of the wire under the feet as each is released in turn with the soldering iron, starting at the near end. When fitting a chip component, anchor it with a pinhead-sized blob of Blu-Tack before soldering it in.

Various jigs are available from the manufacturers. Relevant to all makes and models are the following Sony alignment tapes: tracking WR5-1C; r.f. sweep WR5-2C; LP colour bars WR5-3CL; colour bars with PCM audio WR5-3CSP. These are not cheap, and one cannot help but wonder why their features could not have been incorporated in a single cassette. Also available is the J608-082-4A forward/reverse torque cassette and a head lapping tape for bedding in newly fitted heads. For individual models a wide range of jigs, gauges, extension leads and switch boxes is available.

Fig. 41 shows a linear presentation of the Video-8 tape path. Guide 1 can be adjusted vertically: its upper edge contacts the tape. It is set to poise the tape slightly above the "shelf" machined on the lower drum, in preparation for the action of guide 2 which is adjustable in respect of height and tilt. Neither of this guide's flanges contacts the tape. Its tilt biases the tape downwards on to the guide machined into the lower drum casting – in similar fashion to the slant poles in VHS machines. Guide 3 has little effect on tape running or tracking: its main function is to absorb tape tension fluctuations as the tape runs on to the drum.

The first guide encountered at the exit side of the drum is no. 4 which, like guide 3, smooths the running of the tape. The main governor of the wrap exit angle is guide 5 which is adjustable for height and tilt. Its upper flange contacts the tape and adjustment is made for a flat waveform at the end of the head sweep of the alignment tape. The alignment of guide 6, beyond the capstan, is for tape running in the reverse mode. The following guides, 7 and 8, are not adjustable: they are tape-steering rollers on the threading ring. Guides 9 and 11 are deck-mounted pillars which define the tape's routing on its way on to the take-up spool. They work in conjunction with guide 10 which is one of the pull-out poles used for tape threading: its action was described in an earlier instalment in this series.

The actual positions of the guides with the tape threaded and running are shown in Fig. 42. The action of the ATF servo system will mask a great deal of misalignment of the crucial entry and exit guides – the situation is akin to trying to tune in a TV set with the a.f.c. on. A track shift and monitor jig is available from the manufacturers to overcome this problem: it gives you back an "adjustable" tracking control potentiometer.

How do you set up the guides on the record-only Handycam Model CCD-M8E? The above-mentioned track shift and monitor jig provides a playback f.m. signal envelope from this camcorder as well as "spiking" the ATF circuit. The tape path in this compact machine is quite different from that shown in Figs. 41 and 42 – in fact it's almost identical to that of a VHS machine. Fig. 43 shows the arrangement. The guides have similar functions to their counterparts on a VHS deck, nos. 3 and 6 having the greatest effect on the tracking.

Many physically small fuses are used in Video-8 hardware. The rating is stamped on them in coded form, i.e. N10, F25 etc. Multiply the number by 40 to get the rating in mA – this also applies to the same small fuses fitted in JVC/Ferguson equipment.

It's too early yet for any fault patterns to have become established or to be able to suggest diagnostic procedures. Very little has emerged so far by way of servicing experience – apart from the fact that the heads have to be cleaned at too frequent intervals! In fact the products are proving to be reliable. The need for frequent head cleaning seems to arise from a ready migration of the tape coating on to the heads. It's worse with some batches of MP tape than with others. I've encountered the problem to some extent with all makes of tape so far tried – maybe they all come from the same factory anyway!

Regarding other faults and bearing in mind the need, more than ever before, to separate the diagnostic and repair procedures, it pays to study and analyse the symptoms carefully. Thus corrupt or intermittently muted PCM sound should lead first to a check on the alignment of the entry guide; mistracking to an investigation of the SEL1 and SEL2 lines and the effects of the TSA and TSB outputs; unstable capstan operation to an initial check on the SP/LP auto playback switching as an indication of TSB functioning; incorrect chroma levels to a test for the presence and effect of the burst-emphasis gating pulse; and so on.

In Conclusion

There is tremendous rivalry on an international scale between the protagonists in the battle between the Video-8 and VHS/VHS-C systems, led on one side by Sony and on the other by JVC. Philips, originally a leading contributor to the Video-8 blueprint, is currently selling VHS-C clones, which seems a shame from where I'm sitting. Apart from Sony, who have been backing the new format very strongly, and Pioneer who currently market "badged" Sony camcorders, those so far committed to the Video-8 system are companies in the photographic fraternity: Video-8 products are currently available from Aiwa, Canon, Minolta and Pentax – the Canon and Pentax models are independent designs.

The performance of Video-8 tape and equipment seems to me to be excellent. There are particular advantages in the high quality sound systems, the long running time and the tiny cassettes. Market surveys suggest that Video-8 is taking a large and well-deserved section of the camcorder market, and that home-base Video-8 decks are selling well for both audio and video use. By the time this appears in print the Sony "Professional" Video-8 CCD-V100 outfit should have had time to become established. I for one hope that Video-8 does well: it deserves to!

The Video-8 format does not at present cater for Secam colour – only PAL and NTSC versions of the basic format are available. For use with Secam TV signals an additional chip and peripheral components are required in the machine, in the form of a transcoder that works during record and playback as a PAL interface.

My grateful thanks are due to the Technical and Training Departments of Sony (UK) Ltd. Sony have gone to a great deal of trouble to make available in-depth technical information on the system and their products. I'm in particular indebted to their Mr. Garry Godfrey, an erudite and much-travelled soul who has answered my questions with the patience of Job.

Budget Variable Power Supply

William Harrison

Eugene Trundle's test report on a commercial bench power supply, in the May issue of *Television,* stressed its many uses in the workshop. Impecunious engineers, or those who need a unit for less exacting requirements than E.T., may care to try this DIY model. The circuit is shown in Fig. 1 and it can be built at very little cost. It was originally made to power radio receivers, but its 2A output is suitable for use with monochrome portables. The output could probably be increased by using a Darlington as the series regulator transistor, in conjunction with a larger mains transformer of course.

The design is based on the venerable 723 variable voltage regulator chip. There's protection via the 0.33Ω current sensing resistor and feedback to the i.c. at pin 3. The reference voltage appearing at pin 6 feeds the set voltage control which enables the output to be varied between 1.8V and 15V.

Most of the parts required are on offer by advertisers in the magazine. 15-0-15V mains transformers are available from J. and N. Bull Electrical and from Sendz Components – they are designed for use with monochrome portable TV sets. Sendz offer 4,700μF or 2,500 + 2,500μF electrolytics, 3A diodes and the 2N3055. The LM723 is available from Grandata. The prices they quote won't break the bank!

A multi-turn potentiometer for the set voltage control is money well spent, also extra flexible wire with crocodile clips and covers for the output leads. Get decent analogue meters, an i.c. holder and a good heatsink for Tr1 – suitable types are the Maplin FL54J and HQ70M, or you could bolt the transistor to a substantial metal case area.

The formula for calculating the value of the ammeter shunt resistors is Rs = Rm/(M − 1), where Rs is the shunt resistance value, Rm the meter resistance and M the multiplication factor.

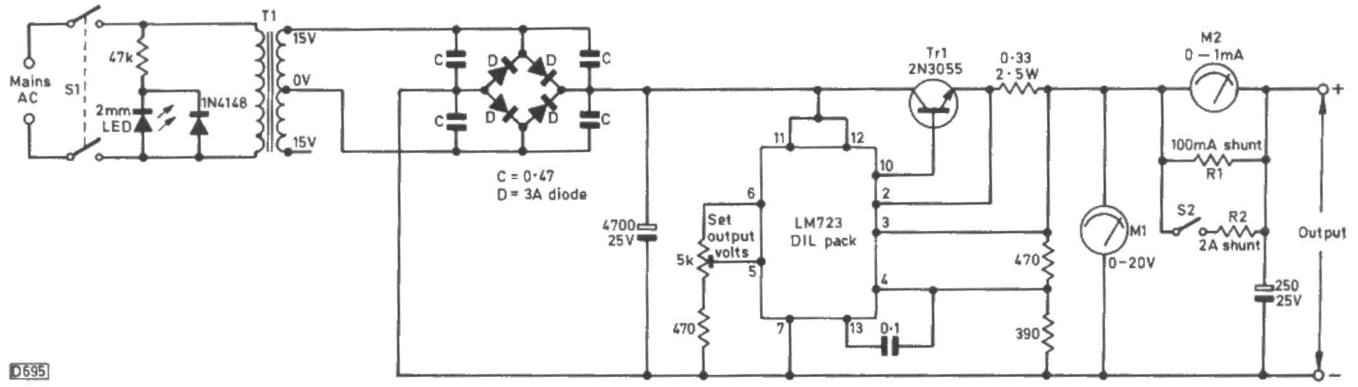


Fig. 1: Circuit of the budget variable power supply. Ammeter M2 is shunted for 100mA and 2A f.s.d. – the formula for calculating the values of shunt resistors R1 and R2 is given in the text. In the prototype S2 is a 10A rocker switch.

Servicing with a Probe and Pulser

David Botto

Perhaps the biggest problem that service engineers face today is in coping with the complex digital circuitry encountered when repairing VCRs. Hours can be spent in trying to locate the cause of problems in the system control circuitry – possibly with only one function refusing to work. After a lot of testing expensive logic or microcomputer chips may be ordered from the manufacturers, but when they finally arrive and are fitted the problem may still be present. The VCR may then be put aside while the engineer desperately tries to catch up with a pile of TV sets and other VCRs, and the odd microcomputer that awaits his attention – and here again he encounters plenty of digital circuitry.

The use of a logic pulser and probe greatly facilitates fault-finding in digital circuitry. In a previous article (see *Television,* November 1985) we described the use of a probe, something many TV engineers now possess. The probe is extremely handy since by simply touching its tip on the point under test an instant indication of the circuit condition is obtained – it does this by indicating the presence of a binary one (high), a binary zero (low) or a fast-changing logic level. The probe is thus essentially a signal tracing device that enables you to follow the progress of digital signals through the circuitry. It can be compared with the old-time signal tracer (used back in radio servicing days) with which you could follow the signal from the aerial to the loudspeaker. But instead of registering the presence of an analogue signal the probe registers the presence of digital information. What the complementary logic pulser does is to generate digital signals that can be detected by the probe, thus enabling you to check the operation of logic circuits in detail.

Until recently several different pulsers were required to cope with the various logic families. The cost of purchasing them could be well over £100. It's now possible however to obtain at modest cost a logic pulser that operates effectively with all types of logic circuitry.

The circuit of a simple logic pulser you can build is shown in Fig. 1. It generates a series of digital pulses at a frequency of about 5Hz. If you like to experiment, this is a handy circuit. It's not really suitable for practical servicing however.

Pulser Features

When you buy a logic pulser, check that it has the following features. (1) The ability to operate with d.c. supplies between say 4·7-15V with reasonable current consumption, and that it's protected against overloads and wrong polarity connection. (2) The provision of an additional (removable) chassis earth lead is handy so that the pulser can draw power from the circuit under test or from a separate power supply. (3) Full compatibility with CMOS, MOS, TTL and other types of logic circuitry. This should include memories and microprocessor/microcomputer i.c.s etc. (4) The ability to generate a continuous digital pulse train and single pulses, with switch selection. (5) Indication of output and overload conditions – coloured LEDs are generally employed for this purpose. (6) The pulser should be light and easy to handle and at the same time robust enough to stand up to workshop conditions.

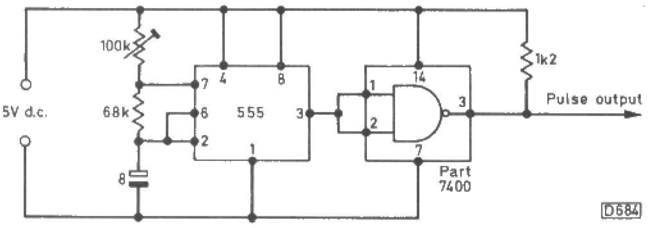


Fig. 1: A simple logic pulse generator circuit that will act as a very basic pulser. The component values can be varied to give different output frequency ranges.

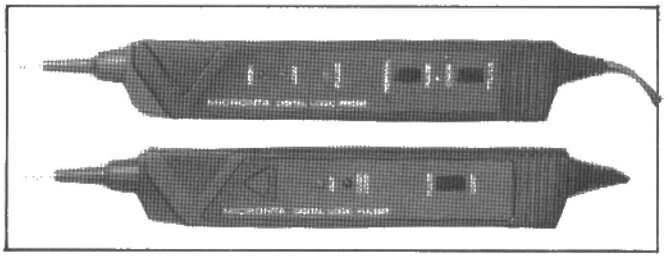
Fig. 2 shows the circuit of a logic pulser (Tandy) suitable for professional TV, VCR and microcomputer servicing. It employs a number of discrete transistors and four nand gates which are contained in an MC14093BCP chip. When switch SW1 is pressed pin 13, connected to one of the inputs of nand gate one, changes from the binary one (high) state to binary zero (low). With SW2 in the pulse selection position the circuit acts as a one-shot multivibrator, producing a single 5μsec pulse which is fed to nand gate four. With switch SW2 in the continuous position the circuit acts as a clock oscillator, producing a continuous 5Hz signal. Nand gate four simply buffers and inverts the signal which is amplified by transistors Q12-Q17 and fed to the probe tip. The signal at the junction of R18/R19 is fed to the base of Q3 which drives the green led LD1. This gives an indication as to whether a pulse or continuous output is present at the probe tip. D1 provides protection in the event of an incorrect polarity supply being connected to the pulser. Conventional supply voltage regulation is incorporated. Should an overload at the probe tip cause excessive current to flow the red warning led LD2 will light. Fig. 3 shows the pulser's output waveforms.

Logic Gates

By now you'll no doubt be familiar with the symbols used for the standard types of logic gates and their truth tables. For convenience they are shown in Fig. 4 and Table 1 respectively.

A Caution

Before discussing servicing procedures, a note of caution. If the pulser is powered from a d.c. supply that's



The Micronta digital logic probe (top) and pulser (bottom). Available from Tandy under catalogue numbers 22-303 and 22-304 respectively.

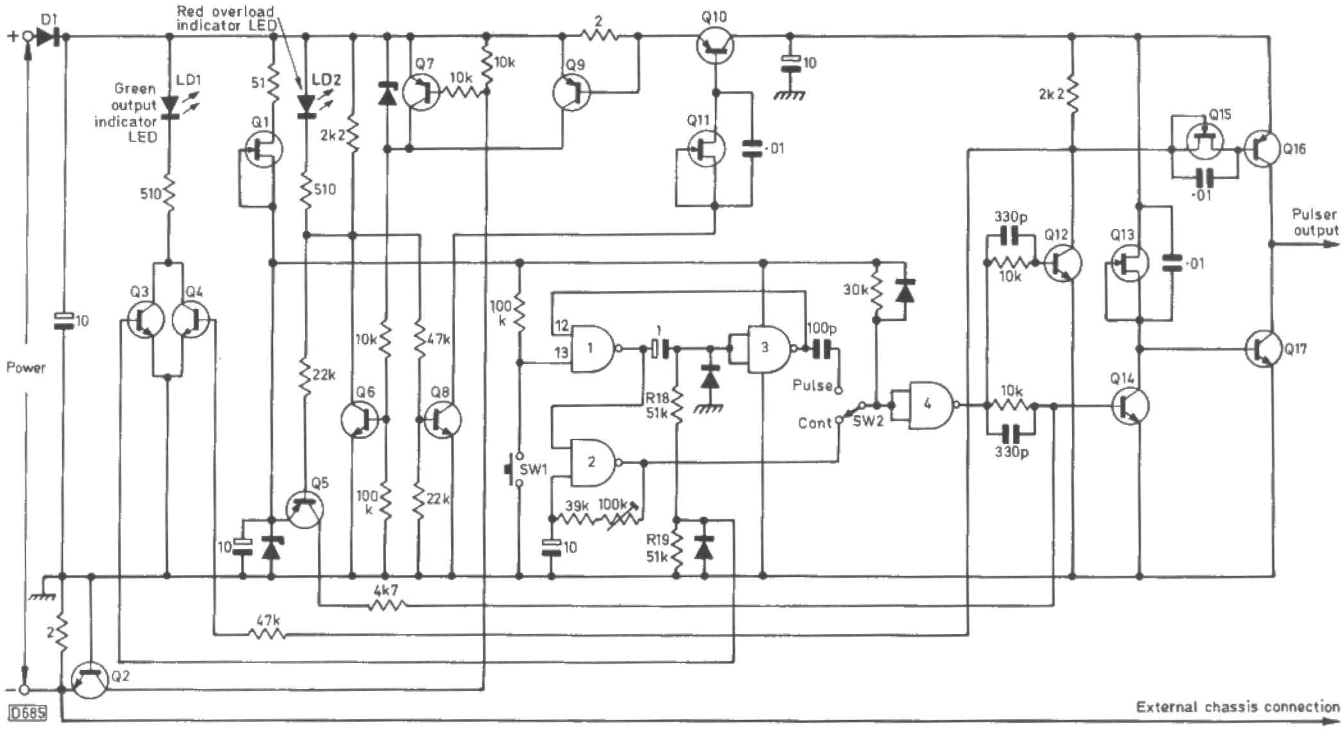


Fig. 2: Circuit of the Tandy logic pulser.

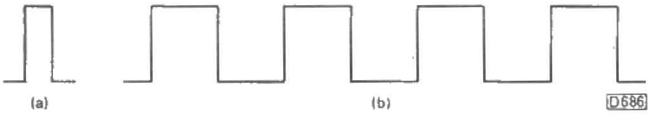


Fig. 3: Outputs produced by the Tandy pulser. (a) A single 5µsec pulse. (b) A continuous 5Hz pulse train.

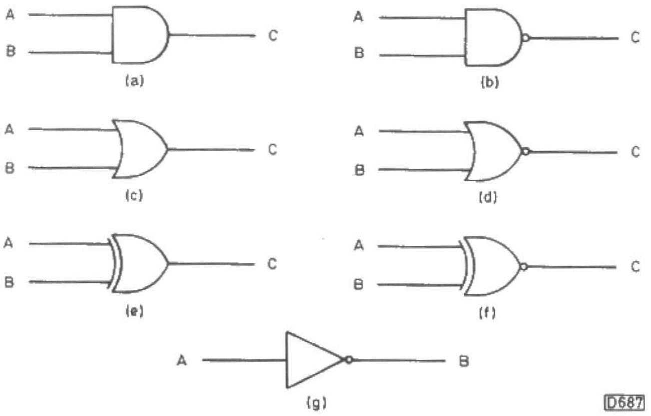


Fig. 4: Standard logic gate symbols. (a) And gate. (b) Nand gate. (c) Or gate. (d) Nor gate. (e) Exclusive-or gate. (f) Exclusive-nor gate. (g) Inverter – sometimes referred to as a not gate.

separate from the equipment under test, make sure that this d.c. voltage never exceeds the supply voltage of the digital circuitry you are testing. Otherwise damage to the circuit could result. In practice however the power supply of the circuitry under test is almost always used.

Servicing Procedures

In most digital circuitry the logic inputs and outputs change at a fast rate. By using the low-frequency pulses or single pulse from the logic pulser the changing logic levels can be slowed down and more easily checked with the logic probe. Without the pulser you have to rely on the pulse indication given by the logic probe alone. It's also useful to be able to check logic i.c.s out of circuit. Logic i.c. testers can be bought but are very expensive. The TV/VCR engineer will find that an inexpensive solderless breadboard is handy for these tests – it will also help you to appreciate digital logic circuit operation! The chips in some of the equipment you service may be connected into circuit via plug-in sockets and thus be easy to remove: or you may wish to check a logic chip before fitting it.

Testing Gates

Fig. 5 shows the test method for an and gate (remember that an and gate can have two or more inputs). All inputs except one are connected to the supply line. The pulser's

Table 1: Logic gate input/output conditions.

And gate			Nand gate		
A	B	C	A	B	C
L	L	L	L	L	H
L	H	L	L	H	H
H	L	L	H	L	H
H	H	H	H	H	L

Or gate			Nor gate		
A	B	C	A	B	C
L	L	L	L	L	H
L	H	H	L	H	L
H	L	H	H	L	L
H	H	H	H	H	L

Exclusive-or gate			Exclusive-nor gate		
A	B	C	A	B	C
L	L	L	L	L	H
L	H	H	L	H	L
H	L	H	H	L	L
H	H	L	H	H	H

output is connected to the remaining input. The output indication obtained using the probe should follow the input. Check each input in turn with the pulser while the other inputs are connected via the switch to the supply line. This test can reveal a logic gate fault where a static d.c. test may not. Use the same procedure with a nand gate, only in this case of course the output will be the opposite to the input.

In practice the and and nand gates encountered in servicing are usually simply two input only gates and in domestic equipment are soldered into circuit. If you suspect a particular gate in a piece of equipment first check the supply voltage to the chip, using a digital voltmeter, then simply desolder the gate's inputs. Connect one input to the supply rail and connect the pulser's output to the other – see Fig. 6(a).

With an or gate all inputs but one should be earthed – see Fig. 6(b). Again the output should follow the input. With a nor gate the output is inverted.

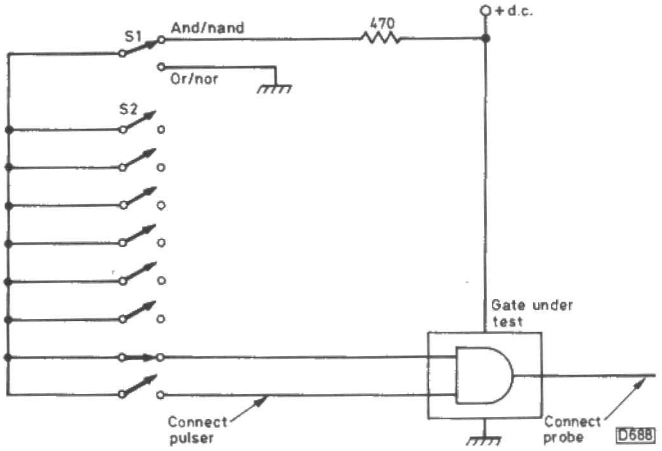


Fig. 5: Solderless breadboard check for an and gate. The method is the same for a nand gate. For an or or nor gate the common connection of the gate input switch is taken to chassis instead of to the positive side of the supply. Dual in-line pack switches (S2) are available from suppliers such as Maplin (catalogue number XX27E).

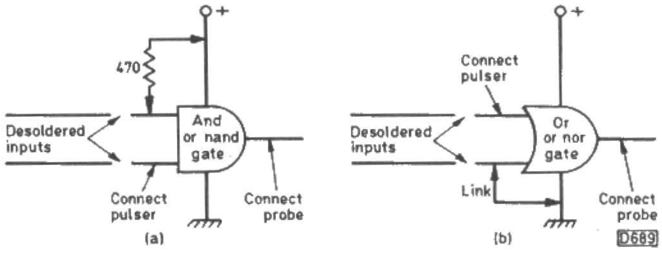


Fig. 6: In-circuit gate tests.

Testing Flip-Flops

You'll remember that a flip-flop is a two-state logic circuit which stores one bit of binary information. Its two outputs are referred to as Q and inverted-Q. When the Q output stores a binary one (high) the inverted-Q output is at logic zero and the flip-flop is said to be set. With the Q output low and the inverted-Q output high the flip-flop is said to be reset.

Fig. 7 shows a D flip-flop. To test this in circuit check the T and D (data) inputs with the probe. Provided the T input is high (or being driven at high speed by pulses from a clock oscillator) the Q output should follow the D input. Before replacing a suspect D flip-flop desolder the D input pin and if the T input is not high, or is not being driven by clock pulses, unsolder the T input and connect it to the supply line via a 470Ω resistor. Feed the pulser's output to the D input and monitor the Q and inverted-Q outputs with the probe. If all is well you'll see the outputs change as the D input changes. When the T input is connected to chassis the flip-flop should ignore the output from the pulser and stop.

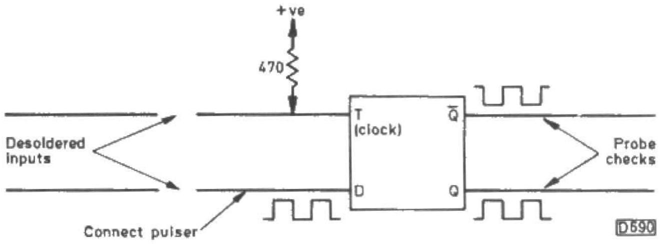


Fig. 7: Testing a D flip-flop.

You'll often encounter the JK flip-flop in VCR and computer circuitry. A block diagram of the internal circuitry of a typical JK flip-flop is shown in Fig. 8. Notice that it has two main sections, a master and a slave flip-flop. Two such flip-flops are contained in the commonly used SN7476 i.c. First use the probe to check that the preset and clear lines are high – these lines are internally connected in some JK flip-flops. The JK flip-flop can continue to respond to the clock signal only when both the J and K inputs receive logic ones or are connected so as to be permanently high. When a clock pulse is present at the T input the logic probe should indicate that the JK flip-flop is rapidly setting and resetting.

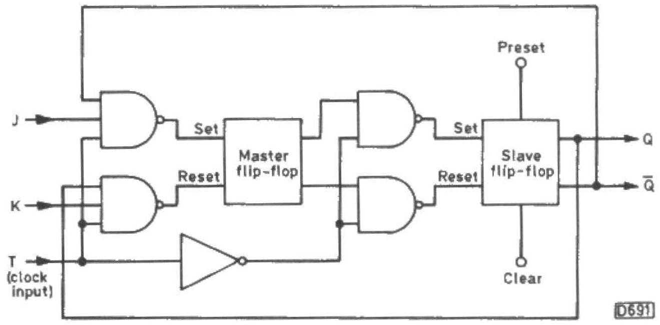


Fig. 8: Block diagram of a typical JK flip-flop.

If you suspect that a JK flip-flop has failed and you're not sure whether the flip-flop i.c. or associated circuitry is faulty, desolder the pin for the T or clock input and connect the pulser to it. With a continuous 5Hz input the Q and inverted-Q outputs should set and reset at a rate of 2·5Hz. This is because the master flip-flop must set and reset first before setting and resetting the slave flip-flop. For this reason the JK flip-flop is sometimes used as a frequency divider. Fig. 9 shows the duty-cycle waveforms. It's easy to remove and check a JK flip-flop on your breadboard: unfortunately in TV and VCR work they always seem to be well soldered in!

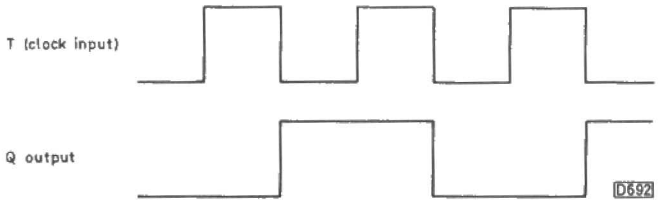


Fig. 9: JK flip-flop duty cycle waveforms with the J and K inputs high or disconnected. Top, clock input (T). Bottom, Q output.

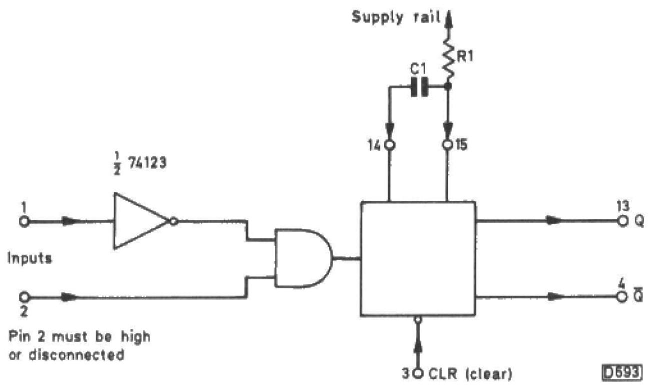


Fig. 10: Block diagram of a one-shot multivibrator.

Another logic chip often encountered in VCRs and microcomputers is the one-shot multivibrator, which is sometimes called a retriggerable multivibrator. When the one-shot multivibrator detects a trigger input pulse it generates a single output pulse. Fig. 10 shows the circuit symbolically. An SN74123 i.c. contains two complete one-shots. To test the operation, first check that the CLR (clear) input is low, using the probe. Then disconnect pin 1 (in this case) and apply to it a pulse from the logic pulser. If capacitor C1 is of low value the output pulse at pin 13 may be detectable only via your logic probe. If C1 is of large value the pulse may last for more than a second. C1 could be anything from 15pF to 1,000μF depending on circuit requirement.

Practical Servicing

When tackling a piece of equipment it's a good idea to start by studying the service manual to try to see how the system is supposed to work. Don't forget first to ensure that the correct supply voltages are present. With VCRs especially it's well worth making sure that the fault is in the logic circuitry and is not due to some external cause. For example, a slack loading belt in the Panasonic NV333 VCR will cause the capstan motor on signal from the system control microcomputer to stay low when it should be high. Also check that the various switches, such as the cassette down switch etc., are clean and in good order.

The usual faults in digital/microcomputer circuitry are short-circuits, open-circuits and incorrect logic levels, plus problems caused by halted clock oscillators – and sometimes an off-frequency oscillator. Thus problems in digital circuitry can in the main be tackled by the TV/VCR engineer with a digital voltmeter, a logic pulser and a logic probe.

The pulser is particularly useful when fault tracing in circuitry that consists of a combination of various logic devices, perhaps contained in a single i.c. package. IC6002 in the Panasonic NV7000 VCR is such a package. At first sight when you encounter it in the circuit diagram testing might appear to be a formidable task. As Fig. 11 shows however the i.c. simply consists of eight D-type flip-flops and is thus quite easy to check.

The first in-circuit tests are made with the logic probe. Pins 1 and 2 are supplied with clock pulses from the controlling microcomputer chip. The probe should show L + P + very dim H at these pins. Remember that without the presence of these clock pulses the flip-flops cannot change state.

As the various VCR functions are selected the logic levels at pins 3-6 will change. So too should the Q outputs of each pair of flip-flops whose D inputs are joined internally. For example, if the fast-forward button is depressed (with a cassette loaded of course) the logic probe should indicate H + P at pin 3. Connect the probe to pins 11 and 15 in turn and check that the logic levels change.

If the chip doesn't seem to be functioning and you're not sure if the problem is in the device itself or somewhere else, first make sure that the clock pulses are present at pins 1 and 2 then desolder pins 3-6. Set the pulser to provide a continuous output and apply it first to pin 3. Connect the logic probe to pin 11 then to pin 15. The logic levels should change as the relevant flip-flops set and reset.

If you next apply the pulser to pins 4, 5 and 6 you should be able to monitor the changing logic levels of the Q outputs at pins 10, 14, 9, 13, 8 and 12 in turn.

When checking microcomputer and microprocessor chips it's best to use the probe – you've probably noticed that *Television* servicing articles often include helpful lists of the logic levels found at the pins of these i.c.s. The logic pulser comes in when input signals to such chips are missing. The pulser-probe combination enables you to check the various devices that feed signals to the microcomputer or microprocessor i.c.

Suppose that some or all of a VCR's functions fail to occur when the relevant key-matrix function buttons are operated. With many types of VCRs you'll often find that a signal from the pulser applied to or near the function control connections will initiate the relevant VCR operation without the button(s) being depressed. In this case you'll know that the fault is in the small area of circuitry near the function keys, making location of the fault an easy matter.

Particularly in VCRs, various sensors often drive logic circuitry. If the circuit doesn't operate as it should and the supply rail d.c. voltage is correct, has the sensor unit failed or is the problem in the logic circuitry? The fast way to find out is to feed a signal from the pulser into the

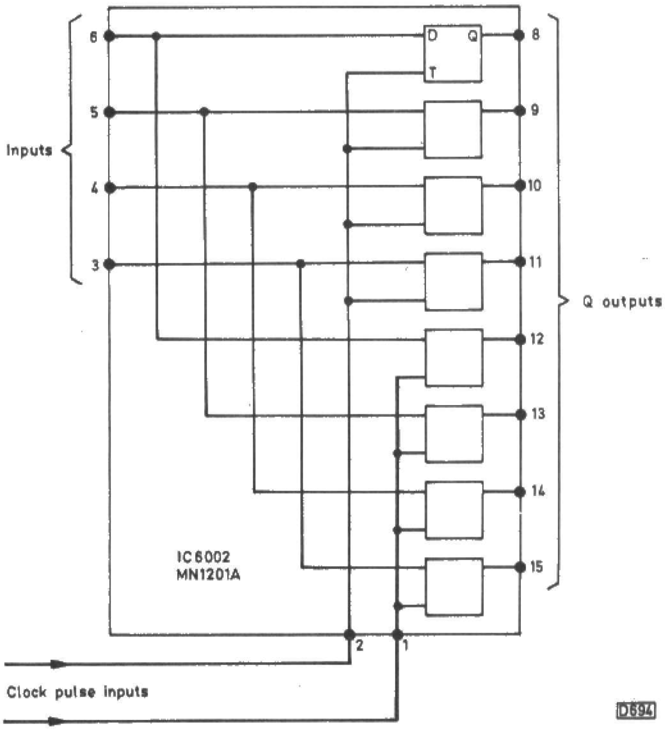


Fig. 11: IC6002, type MN1201A, in the Panasonic NV7000 VCR contains eight D flip-flops.

circuitry. If the circuit then operates the sensor is faulty.

Another handy test using the two probes is in speedy location of print breaks. If, in the absence of a logic signal, you suspect the printed circuit board tracks, trace along the print with the logic probe. Should the logic signal suddenly appear you know you've found the break. If an input to a logic device is missing and you suspect the print, activate the device with the pulser and check its output with the probe. Move the pulser's probe slowly away from the input connection to the device. If the device suddenly ceases to work or changes state then again you know you've located the print break.

Print shorts or an overload caused by some other faulty component in the circuit often stop a suspect digital device from working. If you think that this may be the case, desolder the output pin(s) and check it again with the probe and pulser.

It's not too difficult to check the digital channel indicators used in TV sets and VCRs using a pulser and probe. In fact when the pulser's signal is supplied to the serial data input connection of the logic decoder that drives the display the segment display should go round and round, showing all the numbers in turn!

The logic pulser and probe are also useful when checking the digital circuitry used in remote control and digital tuning devices.

When servicing a TV set, VCR or microcomputer, don't forget to make notes in the manual of the various logic levels you encounter. Include in your notes the effect of injecting logic pulses into various sections of the equipment. Quite soon another of the same type of set or whatever may confront you and you'll be glad you made those notes!

Boolean Algebra

A basic understanding of Boolean algebra can be helpful when dealing with complex blocks of circuitry. This subject is outside the scope of the present article but a few basic points may be useful. Note first that the rules of Boolean algebra differ completely from ordinary algebra. Fortunately it's much easier to learn! Boolean algebra serves as the special language of digital logic circuits – it's the next step forward from truth tables.

For example, taking the and gate shown in Fig. 4(a) with inputs A and B and output C, the Boolean expression for the action of this device is $C = A \cdot B$, which is read as C equals A and B. For the or gate – Fig. 4(c) – the Boolean expression is $C = A + B$, the + sign indicating the or function. For an inverter – Fig. 4(g) – the Boolean equation is $B = A$.

In Conclusion

Once you begin to use a logic pulser you'll discover how much faster and easier fault location in digital circuitry becomes. You'll then find that the pulser and probe rapidly become indispensible.

Logic pulsers and probes are now available from sources such as B.K. Electronics, Maplin, RS Components, Verospeed and many other companies. The logic pulser I use is a Tandy 22-304A which costs just £16·95. It comes with an excellent instruction booklet. Most of the above firms also supply solderless breadboards, miniature 8-way SPST DIP switches and suitable connecting wire. These, as indicated in Fig. 5, are useful for checking digital i.c.s out of circuit.

Note that some of the comments in this article relate specifically to the Tandy pulser just mentioned. Pulsers from different sources differ somewhat in their characteristics. With many of them checks can be carried out with no need for any desoldering or PCB track cutting. The moral of course is to read carefully the instructions relating to the pulser you intend to use.

Teletopics

THORN SELLS FERGUSON

In a move designed to create one of the world's largest consumer electronics organisations Thorn EMI plc and the French government owned consumer electronics company Thomson Grand Public have reached agreement on the acquisition by Thomson of the Thorn TV manufacturing subsidiary Thorn EMI Ferguson Ltd. Thomson will pay approximately £90m to Thorn EMI on completion of the sale, which is expected to be in early July, representing a premium over the current book value of Thorn EMI Ferguson. Ferguson has long held a predominant position in the UK market and had a turnover in the year to the end of March 1987 of £300m. Last year the company produced 680,000 colour and monochrome sets and production is at present running at the rate of over a million sets a year. Thorn and Thomson nevertheless concluded, after a joint study of the world consumer electronics market, that both companies would benefit from operating as a single, large European manufacturer, with the improved economies of scale and market shares that this would give. Thomson is at present producing sets at the rate of 2·8 million annually. It has never had anything other than minor representation in the UK consumer electronics market, which is Europe's largest, while Ferguson has had negligible sales overseas. World output of TV receivers by the largest producers in 1986 is estimated by BIS Mackintosh to have been as follows, in millions of units: Philips 6·2, Matsushita 4·7, Sony 3·8, Toshiba 3·2, Hitachi 3·1, Thomson plus Thorn-Ferguson 3, GE/RCA 2·8, Samsung 2·5, Sanyo 1·8, Sharp 1·7. The merged company will be the second largest in the industry in Europe, after Philips. Thomson already has substantial representation in the W. German market, with ownership of the NordMende, Saba and Telefunken brands.

Thorn and Thomson have for several years worked together in the area of colour TV tubes and have been associated, with JVC, in the J2T joint VCR manufacturing venture. J2T is at present producing around 900,000 VCRs a year at plants in the UK, France and W. Berlin. Thorn is to support the new group by entering into a formal, long-term agreement for it to supply sets to the Thorn rental businesses (Radio Rentals, DER, Multibroadcast and Focus TV). See leader comment on page 669.

HUGHES TO BUILD UK's TV SATELLITES

The contract to supply the satellites to be used by British Satellite Broadcasting (BSB), which has the UK DBS franchise, has gone to the Hughes Aircraft Company of Los Angeles. The American company is now part of the General Motors group. Hughes will be supplying two HS376 satellites, equipped with 110W transponders, in a deal that's worth some £200 million. The satellites are due to be launched in late 1989 and 1990. There has been keen competition with British Aerospace and Comsat over the deal to supply the satellites for BSB's services. It's understood that the Hughes success is in part due to the fact that it agreed to take on the financial risks of the launch. The satellites are to be turned over to BSB only after they have been tested in orbit.

UK TV BROADCASTING IN THE 90s

The government is planning to introduce a bill in late 1988 covering changes in UK TV broadcasting arrangements. The main aim seems to be to increase competition amongst the ITV companies, whose present franchises end in 1991. One possible approach under consideration for the next franchising round would be to apply quality tests to applicants followed by tendering. The latter could consist of an initial down payment, an annually adjusted rent, and bids based on a percentage of advertising revenue rather than the present levy on profits. The arrangements covering the financing of Channel 4 could also be changed. The government is thought to be considering the possibilities of adding further terrestrial channels. A study by US consultants CSP International, commissioned by the Home Office, is understood to have suggested a fifth national network in the v.h.f. bands and local stations using low-power u.h.f. transmitters.

VIDEO PRODUCTION

The two millionth 8mm video unit was shipped by Sony in the first quarter of the year, only 26 months after the first 8mm products rolled off Sony's production lines in January 1985. Sony points to increasing world demand for its 8mm video equipment and expects to deliver the three millionth unit within a year. Sony is doubling the output of 8mm camcorders at its W. German plant to an annual rate of 120,000 units and has switched production from the CCD-V100 to the new Handycam Auto CCD-V30.

Monthly output of VCRs at Sharp's Wrexham plant in N. Wales is being increased from 22,000 units to 35,000. Output of microwave ovens and electronic typewriters is also being increased and the plant is being extended to produce photocopiers.

Hitachi is doubling VCR production at its S. Wales plant. Following an investment of some £4·2m the plant will be able to produce 240,000 VCRs annually.

THE COMPACT VIDEO DISC

Philips and Sony, co-licensers of the compact audio disc (CD), announced last February the development of the CD with video format as an extension of the CD standard. The two firms have since been holding discussions with the industry on the official name and logo for the new range of discs. Agreement has been reached as follows: (1) The five inch (12cm) compact disc with video will be called CDV. These discs will contain a maximum of five minutes of analogue video information accompanied by digital audio plus a maximum of twenty minutes of CD digital audio. To differentiate them from the silver audio only compact discs the CDV discs will be golden coloured. (2) In addition, the words "CD Video" will be used as the basic system name, the CD Video system including the hardware (CDV Clip player, CDV Combi player, etc.)

3V23 JVC/THORN

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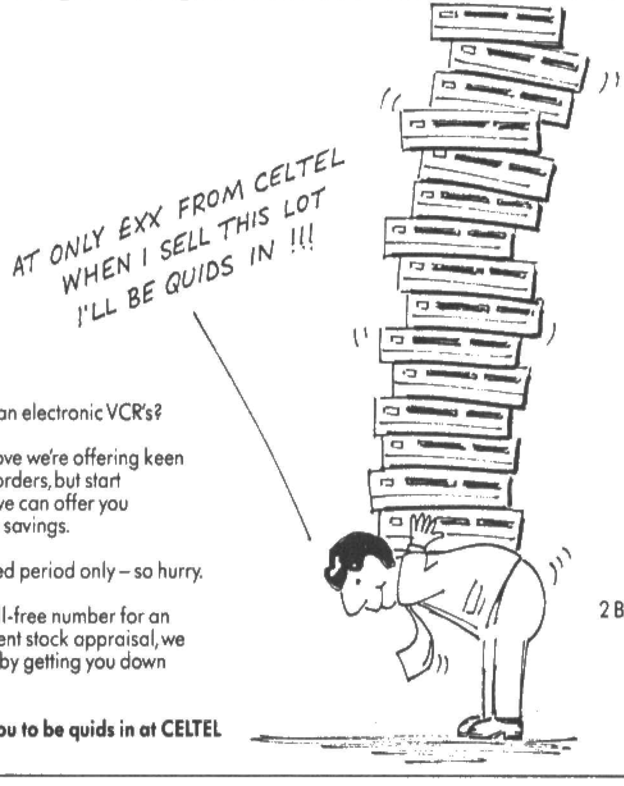
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and the five inch CDV discs and the eight and ten inch laser-read video discs (LD).

The following identification marks will be used: CDV for the five inch discs, LD for the 8/12in. discs, CD CDV for players that play CD and CDV discs, and CD CDV LD for players that handle the whole range of discs.

SPARE PARTS ANNOUNCEMENTS

The supply of spare parts for Ingersoll, York and Thomson consumer electronics products that have been sold in the UK has been taken over by Service All Electronics, 21/22 The Craft Centre, West Wilts Trading Estate, Westbury, Wilts. Telephone 0373 826 739 or, after hours, 0373 865 214.

Spare parts for the Grundig VCR4000 and SVR4004 ranges of VCRs are now available only from Willow Vale Electronics Ltd., 11 Arkwright Road, Reading, Berks RG2 0LU. Telephone 0734 876 444.

NEW FROM MULLARD

Mullard has released a new multi-standard teletext chip, type SAA5250. This is described as a CMOS interface for data acquisition and control (CIDAC) and performs the dual functions of data capture and storage in a separate memory for subsequent retrieval and processing. CIDAC was originally developed for the French Antiope system but will also operate in accordance with the UK and N. American teletext transmission standards. It's designed for use with the SAA5231 video input processor (VIP2) chip. The CIDAC chip controls the separate memory directly, without extra logic, and can be interrogated by a microcontroller chip.

Mullard has also announced a four-chip set to implement pulse-code modulated (PCM) digital audio in VCRs using the 8mm tape format. The four CMOS chips use just 60mW power in total, making them ideal for use in both battery and mains powered equipment. The chip set comprises the SAA1133 analogue/digital interface, the SAA1131 error corrector-1, SAA1132 error corrector-2 and SAA1136 optional ident word interface. The chip set requires only the addition of some RAM to form the complete PCM audio section of a VCR. The Video-8 PCM audio system was described in some detail last month (see pages 609-614).

SHOWS, CONVENTIONS, ETC.

Next year's brown goods trade shows will be held over the period May 15-18th 1988. In the following years it's intended to move the dates back to March, the provisional dates for 1989 being March 5-8th.

The next International Broadcasting Convention is to be held in Brighton on September 23rd-27th 1988. As in 1986 the Convention will be at the Metropole Conference and Exhibition Centre, the Grand Hotel and the Brighton Centre, with the esplanade fronting and linking these locations being used for outside exhibits.

The Institution of Electronic and Radio Engineers has announced that the seventh international conference on Video, Audio and Data Recording will be held at the University of York on March 21st-24th 1988. For further details contact the IERE at 99 Gower Street, London WC1E 6AZ.

The next SIM-HI.FI-IVES consumer electronics and musical instruments exhibition will be held in Milan on September 3rd-7th 1987. The Italian Broadcasting and Telecommunications Show, covering professional audio, video and post-production equipment, will be held in Milan on September 24-28th 1987.

"Broadcast '87", the Frankfurt trade fair for film, radio, TV and video equipment, will be held on October 14-17th 1987.

THORN SELLS EX-RENTAL SETS

As an experiment, limited to the London area initially, Thorn is to sell second-hand, ex-rental sets directly to the public. The sets will be sold through servicing centres as a separate operation under the name Multicare. If the experiment is considered a success the idea might be adopted in other areas.

UNIVERSAL REMOTE CONTROLLER

The Onkyo universal infra-red remote control unit is being introduced by Natural Sound Systems of Watford (092 326 499). It's claimed that the unit can be programmed to control almost any manufacturer's consumer electronics products. It will sell for around £120.

VIDEO ROUND-UP

Mitsubishi has launched an S-VHS VCR, Model HVF23, in Japan. Production will be at 5,000 units a month initially and the selling price will be the yen equivalent of about £935. Loewe Opta has announced its intention to show an S-VHS machine at this year's Berlin International Audio and Video Fair.

Sanyo's latest VHS VCR, Model VHR3100E, features super-slim styling, being just 89mm in height. There's a SCART socket as well as the usual standard u.h.f. output. The suggested retail price is around £350.

Steepletone Products Ltd. (Park End Works, Northants NN13 5RD, 0869 810 081) has introduced a video tape winding and cleaning unit which is expected to sell at about £30. It will rewind or wind forward an E180 tape in two and a half minutes. Use of the winder reduces VCR wear and enables a tape to be prepared for use whilst the VCR is in operation. The winder has a resettable three-digit counter, an auto brake arrangement and a button to bring the cleaning system – a spirit impregnated pad – into operation. The unit comes complete with six replacement pads.

The latest issue of the Society of Electronic and Radio Technicians' journal *Electronic Technology* contains a useful guide to fault location in VHS machines. Well worth study if you know a member who will lend you his copy.

IN BRIEF

Matsushita is to supply its new video recording system, the half-inch M2 format, to Thames Television in a deal likely to be worth £8-10m over four-five years. The equipment is already in use in Japan and USA for both studio and outside broadcast applications . . . China has announced a major order from Canada for 700,000 14 and 22in. colour TV sets. The country already exports to Hungary and the UK. There is also to be a joint Chinese-Canadian VCR production venture . . . A US toy manufacturer, Fisher-Price, intends to market a cheap camcorder that will record eleven minutes of monochrome TV on a C90 audio cassette (five and a half minutes per side). The Pixelvision camcorder will be sold for about £95. It has a stationary video head, a fixed-focus video camera and a deck that will run for five hours on six AA alkaline batteries.

The Computer as an Aid to Servicing

Part 3

Chas E. Miller

We've already looked at ways in which a computer can be used to simplify the stocking and handling of spares, to provide an indexing and locating service for manuals and so on. We'll now examine the possibilities of keeping useful service records for sets on rental or on maintenance contracts. It's clearly of great importance to know just how much is being spent on the upkeep of such sets – apart from the advantage of being able to refer back to see whether a particular part has been changed in the past, and if so when.

In determining the best way to set up files we must consider the provisions of the Data Protection Act, 1984, which came into force last year. Briefly, the Act sets out to control the storage and use of personal information in computers and other equipment. It gives an individual the right of access to any files which he believes might hold such information, and requires people who operate personal data storage systems to register with the appropriate government department. Exemptions are set out at some length (part iv, 31-35) and come chiefly under four headings – club membership records, domestic records, payrolls and accounts. Only living individuals are covered by the Act, so there's no restriction on the names of companies, organisations and so on. Furthermore it's permissible to file names and addresses only when these are to be used for "preparing the text of documents". This appears to mean that if you have entries such as "J. Smith, 99 Peabody Buildings, Upper Spranfield" for the purpose of making up say a monthly account or an occasional bill registration is unnecessary. If you should wish to add any additional information however, such as "age 29", "bad payer" or "husband works funny hours", you will have to register. Note that keeping written comments of this type is not restricted. If you set up your computer files suitably there should be no problem.

The sort of information that's likely to be most useful when stored is the customer's name and address, the make and serial number of the equipment, the date of purchase or commencement of rental, the dates when servicing has been carried out and the cost of this work. With this basic information in mind we can set up a suitable database file on the following lines – refer back to the previous articles in this series (February and April 1987, and see also the letter in the June issue) for full details of the procedure.

On receiving the prompt and entering the command "create" we receive the usual request for a file name, which might in this case be "Setrecords" or "B:Setrecords" depending on which disc drive is used. The various fields could be arranged as follows:

```
001  Name, C, 20
002  Address, C, 100
003  Set, C, 15
004  Serial, C, 15
005  Purdate, C, 15 (date of purchase)
006  Rendate, C, 15 (date of rental)
007  Serdate, C, 100 (date[s] of servicing)
008  Parts, C, 100
009  Costs, C, 100
```

The 100 character field width allows a fair number of entries but can be modified to suit your own particular needs. A specimen record might look like this:

```
001  Smith, J.
002  99, Peabody Buildings, Spranfield.
003  SuperTV 20"
004  12345
005  12th Aug 1980
006
007  13th Aug 1980, 20th Jan 1983, 4th Nov 1986.
008  Complete new chassis, 3·15A fuse, new c.r.t.
009  u/g, £5·50, £72·90
```

As usual, indexes can be made up to cover the appropriate fields. In this instance the customer's name, address and type of set will probably be sufficient, for which we use the commands:

```
. Index on Name to Namind
. Index on Address to Addind
. Index on Set to Setind
```

Records can be examined as required at a later date by using one of the indexes:

```
. Use Setrecords index Namind
. Find Smith
. Display
```

Due to the large field widths you may well find that the information is scattered about the screen – the dates especially may be confused. To overcome this (and to make alterations and additions) make a note of the record number and enter the command:

```
. Edit 00001
```

whereupon the record as originally composed will appear on the screen.

You might wish to add a new repair. Use the CR to take the cursor down to field 007 and insert the appropriate date. CR will then take you on to field 008 for the parts used and then to field 009 for the cost of the job. A final CR will bring up the next record for editing. Should you not wish to do this you can escape by using CTRL-W.

A handy way of making it easy to consult the records is to write the set's file number somewhere on the back. Details can then be called up on the computer as soon as the set comes into the workshop and the information can be up-dated as required.

Numerous other items of information can of course be stored. For example a field could be devoted to the monthly (etc.) date when rental or other payments are due or when they are scheduled to finish. If rental sets are disposed of after a certain time in service the projected date for each set could be recorded and the records checked periodically to weed sets out. Other possibilities will no doubt suggest themselves to you. The scope is pretty wide, as any record will accept a maximum of 32 fields, with a maximum of 1,000 characters overall.

Forms for registration under the Data Protection Act are obtainable from main Post Offices or direct from The Data Protection Registrar, Department 1, Springfield House, Water Lane, Wilmslow, Cheshire SK9 5AX.

VCR Clinic

Reports from Christopher Holland, Alfred Damp, Philip Blundell, Eng. Tech. and Eugene Trundle

Ferguson 3V31/JVC HR7650

The complaint with this machine was of intermittent variation in the sound level. The actual problem was not intermittent: there was variation of sound level in the record mode on certain tapes. In fact the problem was confined to a brand new Panasonic tape provided by the customer and an old test tape of ours found lying around in the workshop. Six other tapes we tried worked perfectly, while the two tapes that showed the fault worked correctly in other machines. No displacement of the tape could be seen during record, and small adjustments of the audio/control head didn't improve the situation. A cure was finally provided by a rather unscientific 90° anticlockwise turn of the right-hand tape pillar. **C.H.**

JVC GRC1 Camcorder

Summer is here and it's time to get out the camcorder last used at Christmas! Two of them came into our workshop recently. The first needed no more than video head cleaning but the second appeared to have a more difficult fault. The complaint was that the microphone didn't work, but in fact there was no audio record or playback while the microphone gave good sound through a monitor during recordings.

I always approach these units with a great deal of caution – their intricacy and compact layout demand considerable respect. Luckily this one turned out to have no more than an open-circuit lead to the audio head. Time to repair it: five minutes. Time to uncase and case it: almost two hours – and that's following the instructions in the manual! **C.H.**

JVC HRD140/Ferguson 3V44

This machine would work perfectly for long periods of time but occasionally the capstan would start to speed up, the effect being as if the machine was in the rapid forward search mode but with the sound unmuted. If the tape was stopped and ejected while the machine was in the fault condition the capstan motor would continue to spin. The problem was due to the presence of 10V d.c. at the base of Q603. This wasn't leaking through diodes D606, D607 or D608 but apparently came from the collector of Q603 itself. Even though the transistor read perfectly when checked with an ohmmeter a replacement 2SD637R provided a cure. **C.H.**

Mitsubishi HS306

HS306s don't like smoky houses! The typical fault is that the machine stops playing after ten seconds and the counter doesn't move. This is due to the take-up rotation optosensor and reflective strips being dirty. Cleaning with foam cleaner is all that's required. **P.B.**

Philips VR6462/Finlux VR1010

For low recorded sound with these machines, before suspecting an audio fault try listening very closely to see if the sound is wowing. If it is the sound is being muted, most likely due to a capstan servo fault. If it isn't wowing try cleaning and resoldering the pins to the audio/control head where they connect to the PCB.

If you find poor take-up torque that doesn't respond to replacement of the reel idler or omega spring, remove the two reel carriers and check whether any metal debris are sticking to the magnets on the underside. So far I've had circlips, springs and hairgrips here. If they jam on, the Hall sensor's reel rotation will stop. **P.B.**

Fisher FVHP615

This machine appeared to have a capstan servo fault: after playing for a few minutes the voices would sound like Mickey Mouse and tracking lines would appear on the screen. A look at the servo board revealed that all the i.c.s had been replaced. Someone had been beaten by this one! Luckily I noticed that the reel belt was straining when the fault occurred, so I checked the take-up torque which was much too high. What was happening was that the rewind idler was contacting the take-up spool which was in effect in the rewind and play modes at the same time. A new idler gear and leaf spring were required. **P.B.**

Ferguson 3V35/JVC HRD120

This machine would load, run for five seconds then unload. Watching the head drum it was obvious to us that the motor was running fast. As we had only five seconds to measure voltages and scope waveforms before the machine unloaded we decided to swap the motor with one from a stock machine in order to rule it out. It proved to be innocent, so the scope would have to be connected to each test point in turn then play selected in the hope that something would show. Fortunately the first test point chosen revealed that there were no drum pick-up pulses. The pick-up head was open-circuit. **A.D.**

Grundig VS180 and VS220

The problem with these two machines was intermittent or no play, with F1 flashing in the VS220's display and the pause light flashing in the VS180. The usual cause of this is dirty contacts on the brake solenoid switch S4. Cleaning the switch will restore normal operation – Grundig recommend removal of the plastic dust cover. **A.D.**

Mitsubishi HS318

This machine refused to load a tape and produced a loud clicking noise from the mechanism. Cam gears A and B were jumping back as the machine tried to load. The fault was in the first nylon gear driven by the loading motor – every other tooth on the gear was either missing or badly worn. Similar mechanisms are used in the HS306/7 and HS337/8. **A.D.**

Ferguson 3V29/JVC HRD110

The customer's complaint was that the picture was poor in the forward search mode – there was a large noise bar at the top of the screen. The reel servo voltages didn't tally with those shown in the circuit but proved to be correct when compared with those in another machine. Swapping the servo panels failed to cure the fault so the drum motor assemblies were interchanged. This cleared the fault. When the customer was told the cost of a new drum motor he decided that it was a fault he could live with.

A.D.

Panasonic NV7200

There was intermittent no play with this machine, the fault usually occurring during loading, i.e. the tape would load then unload. When the machine did load everything worked perfectly. Checks on the drum flip-flop and take-up sensor signals were inconclusive because of the nature of the fault. We next decided to run the machine without a tape and check for faults visually. While watching the mechanism during loading we noticed that the cassette lamp flickered due to vibration from the solenoid. No, it wasn't an intermittent lamp but tarnished contacts on the cassette detect leaf switch. **A.D.**

Ferguson 3V29/JVC HRD110

This machine would select the wrong modes, i.e. if the play and record buttons were pressed the play, pause and audio dub LEDs would light up while other buttons including stop had no effect. There were voltage changes at the input to the comparator on the mechacon board but no changes at the output pin. A check on the output from the D-A converter revealed only one staircase instead of a repeated waveform. At the microcomputer chip's key scan port each output produced only one set of pulses. A replacement microcomputer chip cured the fault. **A.D.**

JVC HRD755

This machine would accept a cassette but wouldn't respond to any commands either from the front controls or the remote control unit. If the machine was switched off then on again the cassette would be ejected. If the cassette was then reinserted the machine might work. The fault was eventually traced to a faulty cassette end load switch in the cassette housing. **A.D.**

Akai VS2

Anyone familiar with these machine would consider this fault old hat and wouldn't even reach for the service manual. The machine would load a tape, play for five seconds, then stop and unload. The reels were turning and the clover leaf pattern indicated that the drum was running at the correct speed. At this point we decided that the problem was either in the syscon or that pulses were not arriving at the syscon panel, so a service manual was ordered. When it arrived a read through the circuit description made everything clear. The reel pulses are derived from a LED and phototransistor, the LED being supplied via the cassette lamp. Replacing the lamp cured the fault. At least the initial diagnosis of missing pulses to the syscon panel was correct! **A.D.**

Ferguson 3V36/JVC HRD225

A very intermittent deck shutdown fault was present on this machine. It made two fruitless journeys to the workshop for soak testing before the fault put in an appearance for us. The output pulses from the take-up reel sensor were intermittently absent, triggering the syscon into the alarm mode. We discovered that these sensors can be checked by turning each spool carrier by hand while the machine is in the standby mode with no cassette present. This should result in jumps from zero to 5V at pins 3 and 4 of CN23 on the A/S/M panel – most easily seen on a d.c. oscilloscope. This method gives you the opportunity to check the sensor optocouplers while they're being heated, cooled, prodded and generally harassed . . . **E.T.**

Sanyo VTC5150

Now that these machines have given a few years' service we've had several cases of tape chewing – not for the usual Sanyo reasons but because of a worn pinch roller assembly. The problem is easy to recognise: the tape becomes creased and crinkled across its full width at random intervals. **E.T.**

JVC HRD370

This brand new machine, straight out of the box, failed a predelivery test – the clock functions couldn't be set. In general the mode keys worked while the numerical ones didn't. The cause turned out to be a "silly": the ribbon cable from program board 23 was only half pushed home into CN5 on timer board 15. Its half-cock angle was such that the end half dozen or so of its contacts were making, hence the registration of only some of the commands. Had we not seen this a giveaway would have been that the timer could be fully set up using the remote control handset. **E.T.**

Panasonic NV100

This portable VCR had long been used with a JVC GXN5E camera without problems but was eventually brought in for service with the complaint that use of the camera's run/stop trigger would sometimes put the VCR into stop. On test we found that the stop mode could be invoked very intermittently by going from record to record-pause or vice versa. By a lucky chance we got another GXN5E camera in for service at the same time: the NV100 played the same tricks with this. A somewhat inconclusive scope check around the syscon microcomputer convinced us that the port expansion chip I6003 (type VCR 0060) was the culprit: replacing this cured the problem – well, we've not heard any more about it since the machine went back . . . **E.T.**

Ferguson 3V28 Tuner/Timer

The tuner/timer half of the 3V24/3V28 ensemble gives less hassle than its partnering VCR. This particular one got into trouble only because the yobbos at the local Youth Training Centre had knobbled it by setting the mains voltage selector to 110V. Not surprisingly the 1A mains fuse blew when it was next powered from the 240V mains supply. Several replacement fuses were fed in by the supervisor before he eventually brought it in for attention. The fuseholder is right beside the voltage selector switch, which clearly said 110V!

Under the circumstances they got off lightly. The massive mains transformer was unaffected, as were all the l.t. fuses, the regulator transistors and main rectifiers. Damage was confined to D3 (type 10E2) going short-circuit and a burnt out safety resistor (R18, 2Ω) on the regulator panel. The resulting loss of the 40V line had mercifully cut off the main 12V regulators, while the reservoir capacitors had held out. **E.T.**

Tiny Tim's Triple Trouble

Les Lawry-Johns

Tim sat behind his bench and looked out at the world, or some of it. Pretty girls looked at the door to get a reflection of themselves – this was apparently their favourite occupation. How could they tell their boy friends they loved them? There just wasn't room. Not till they got older and told their children they were selfish.

It's a funny place this world, thought Tim. Then he realised he was the same himself. It was just that he didn't show it so blatantly. He sort of covered it up and pretended he cared for others. Like Tinker Bell really did – not for Tiny Tim of course, but she seemed to care for others.

His eyes strayed under the bench. How did those books of naked girls get mixed up with his service manuals? Oh yes. He was saving them for his brother who liked things like that since he couldn't do anything other than sit in a chair all day and read and watch videos and things. Tim didn't like these rude books. It was just that he had to make sure that his brother wasn't going to see something that would upset him. Besides, he would have to keep them until Saturday so that Phil could read them too.

Mr Golightly's K40

Just then Mr. Golightly opened the door and carried in a Philips K40. "It goes off just when it's getting interesting, and my wife's getting fed up with it and with me" he explained.

Intermittent operation. Tim's heart sank. He wasn't keen on K40s as he hadn't had much to do with them as yet – not like the KT3, which he was always pleased to see, with its unreliable tripler and probably a faulty chip or two, or the usual problem of the 4·7Ω resistor without chip faults.

He removed the rear cover warily, switched on and connected an aerial. A lovely picture appeared and remained. Tim got out the hairdryer but nothing responded to it. He then drew out the lower, centre power panel to see whether heat on this would do anything. Now to get this panel out you have to lower the main panel. Having pushed the power panel back in Tim raised the main panel and the set went off. He lowered it and the set came back on.

"There you are" said Mr. Golightly, "on off, on off".

Tim sighed and peered at the main board closely. A tiny spark caught his eye. Yes, on one of the line output transformer pins. Quick as a flash it was resoldered. "All done Mr. Golightly. See you next year perhaps."

"What? When? Wait a minute!"

Tim moved the main board about and tapped it with the screwdriver handle. "All done. Next gent please."

He wrapped it up and put it back in the car while Mr. Golightly muttered about what his wife would say if it happened again. We haven't seen him since – except when he popped in with half a bottle of Bells for Tim. In fact the poor joint hadn't been cleared that quickly. The pin had been scraped clean before resoldering.

Tim's Second Trial

When two fellows staggered in carrying a big TV set with doors Tim wondered what it was. It turned out to be a fairly old 26in. GEC set of the C2110 variety. Tim felt at home with this type of set and had no qualms about undertaking the repair. The two chaps departed, having given their details, and said they would return later that afternoon.

Tim removed the back cover and went straight to the fuse on the upper left side. It had failed but wasn't blackened. Tim fitted a new one and switched on. The sound came on and the e.h.t. rustled up and Tim felt pleased that he had taken this short cut. The fuse then curled up an failed, and Tim stamped his foot in anger.

He checked the lower centre power unit which said it was in order – the thyristor, the electrolytics, everything. He then checked the line output stage carefully. Again no fault. He remembered Beardy's 3500 and disconnected the tripler, then fitted a new fuse and tried again. The sound burst out but the new fuse died as the previous one had. Tim reconnected the tripler and disconnected the line output transistor. Another new fuse was fitted and this time it held. Tim didn't suspect the line output transistor but changed it just the same. He disconnected all the l.t. lines from the line output transformer just in case then tried again. The fuse failed after thirty seconds. Feeling a bit fed up, Tim tested all the items associated with the line output transistor's base. Everything was in order, but then they would be if the failure occurred only when the set was working. So it would have to be panel replacement.

Tim thought hard, which was something he was not used to doing. What if a replacement panel was fitted? Would they be prepared to pay? Tim put the set to one side.

When the owners (carriers) returned, Tim asked them how much they were prepared to pay for the job. "Somewhere between five and ten pounds" was the answer.

"Clear off" said Tim angrily. So they carried it off and Tim sulked. All that time and worry wasted. He would have to change his ways. But why should he? He'd been doing this job for forty years or so and he wouldn't change now. Oh for a couple of nice G11s.

Mrs Fidler and the G11

Just then the phone rang. It was nice Mrs. Fidler who lives on the outskirts of town. Tim had sold her a Pye G11 some years ago and this was the first time she'd been in trouble. Nice Mrs. Fidler, a young sixty year old, who had her mother living with her.

"Hallo Mr. Tim. Can you come and fix my telly? The tube's gone."

"How do you know the tube's gone Mrs. Fidler?"

"Because there's a white line across the screen. Our neighbour had the same thing and Snappy Repairs took the set away and fitted a new tube. It only cost them eighty pounds."

"I'll come and see to it Mrs. Fidler, and promise it won't cost you eighty pounds." Tim packed his bags and made sure he had some 800mA fuses, a TDA2600 chip and a chip holder. He sped up the road avoiding the dogs who were chasing a bitch on heat. When he arrived he whipped the back off the set and switched it on. There was a supply to the field output stage so the fuse was intact. He unsoldered the TDA2600's heatsink and removed it, having checked that the base of the holder had not been overheating and had no dry-joints. The new TDA2600 was fitted and the heatsink replaced. Upon switching on a nice picture appeared.

"Oh Mr. Tim. It wasn't the tube after all."

"No dear. You're not the only fiddler in town I fear."

By the time Tim got back to the shop the phone was ringing. "The white line is back Mr. Tim."

Tim cursed himself. He hadn't checked the 470μF h.t. reservoir capacitor. He sped back, carrying a replacement capacitor and another TDA2600. Tim looked sheepish when he got there. He removed the 470μF capacitor from the power board. It was a red one and the tags were blackened. After fitting the new welded one and the TDA2600 Tim was rewarded with a nice clear picture. "You're lucky Mrs. Fidler. This could have cracked the tube."

"That's what I told you, Mr. Tim."

"I . . . er. Oh, never mind. Just joking. Goodbye Mrs. Fidler. Have a nice day."

Tim slunk back to his little shop and told Tinker Bell all about it.

"I've heard you tell a million people about that capacitor and what it can do. And when it comes to it you don't bother to check it yourself" she said.

"I know, I know. Silly me."

Wickman Fuses

Oh, incidentally, Wickman fuses (see last month). Ferguson don't call them that. They refer to them as "circuit protectors". They seem to be the same however, like a small black transistor with two legs. But order them as circuit protectors from Ferguson, Wickman fuses from Philips.

Letters

THE TX9 THYRISTOR PSU

Gordon Haigh's article on servicing Ferguson TX9 thyristor power supplies, in the July issue, was timely and interesting. Anyone who has to face these sets in the field will welcome the wealth of advice and information given in the article. Although the TX9 chassis was basically very reliable, the PC1001 and PC1040 versions were prone to fuse blowing caused by repetitive spikes on the mains supply at or near the a.c. waveform's zero-crossing point. Ferguson introduced several modifications, mentioned in the article, in an attempt to overcome the problem. These were successful to some extent but the problem of fuse blowing persisted until the arrival of the PC1044 version with its switch-mode power supply.

If the fuse blows while the receiver is working, a replacement fuse restores normal operation and all seems to be as it should be in the receiver it's likely that the cause of the fuse failure is a spiky mains supply – domestic appliances in the same house could be producing the mains interference.

A few years ago an "unofficial" modification appeared. This altered the operation of the power supply in a way that avoided the spiky mains problem. It consisted of adding a second thyristor to the circuit. An outline sketch of the arrangement is shown in Fig. 1. Both thyristors are triggered via transformer T1 and both are fed with mains a.c. at their anodes. Ferguson made the modification available for the PC1040 board and developed a small modification kit which was issued to some of the more desperately plagued dealers. It can also be applied, with care, to the PC1001 version. The extra 470Ω resistors are ⅛W types and the thyristor labelled SCR4 should be of the same type as SCR1. Where W66 is fitted it can be removed: the network C142/R173/W74 across SCR1 can also be removed.

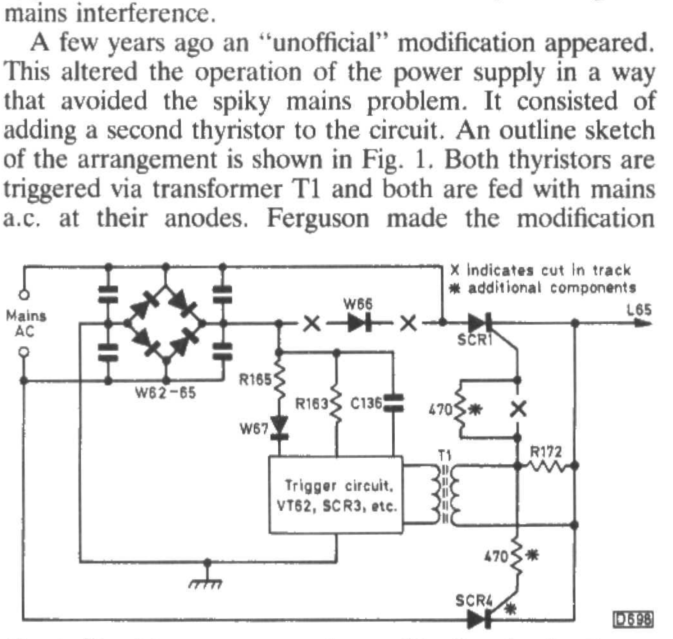

Fig. 1: Thyristor power supply modification for the Ferguson TX9 chassis. Note that in the PC1040 version W66 is omitted and R165/W67 are interchanged.

This modification made life a lot easier for many service engineers.

Harold Raven,
Nottingham.

THE FLAT SATELLITE TV AERIAL

Publicity has been given recently to a small, flat, wall-mounted domestic aerial for satellite TV reception. It's certainly an extremely appealing idea and has been generally welcomed. For the present and for the forseeable future however it's likely to remain just a concept. There's no question of a new generation of flat "dishes" suddenly replacing the conventional parabolic dish. In the fullness of time the flat satellite TV aerial will undoubtedly come into its own, but at the moment its development is inhibited by manufacturing costs and the challenge of perfecting viable electronic steering from satellite to satellite.

It's claimed that the cost of a flat dish aerial is thirty per cent higher than that of a parabolic dish giving the same performance, and that a smaller surface area is required for the same performance. This cost figure could be a gross underestimation in view of the fact that the main receiving elements on the flat aerial must be etched to provide ¼ or ⅛ wave sections with a manufacturing tolerance of less than a thousandth of an inch. The distances between the large number of these sections have to be maintained at an even closer tolerance. In addition, the surface must be kept perfectly flat. If these criteria are not meticulously adhered to the signal picked up by some of the sections may be out of phase with the signal picked up by other sections, the result being phase cancellation.

At its current stage of development the flat aerial, whether mounted on a roof or wall, would need a conventional azimuth/elevation mount and would require the same degree of care in alignment as a conventional parabolic dish. An electronically steerable flat aerial could indeed be mounted in an arbitrary position, but electronic steering is a long way off and is unlikely to be available in the consumer satellite TV market. Electronic steering is expensive because it needs a powerful microprocessor to provide control. The flat aerial would have to have a larger surface area than a parabolic dish that's mechanically steered to point directly at the satellite – deviation in either azimuth or elevation reduces the effective area of a flat aerial. The flat dish is really suitable for use only with the high-powered DBS satellites that are not due to start transmitting to the UK until 1989/90.

I hope that these observations will have put the flat dish development into a more realistic context and timescale. Yes, the flat aerial is coming. But not yet. The conventional TVRO parabolic dish will be with us for a good long time to come.

Michael J. Stone,
Chairman and Technical Director,
Satellite Technology Systems Ltd.,
Bristol.

RECENT PHILIPS TV CHASSIS

I found Harold Peters' article (June issue) on recent Philips CTV chassis most interesting. My own set is an upmarket stereo "glass plate" model fitted with the System 4 chassis. The overall performance is excellent, though I've experienced many of the problems outlined in the article plus a few others.

My receiver has the TRD4 tuning system and has suffered from the usual drifting symptoms on BBC-2 (channel 64) only. Philips advised tuning the set upwards, in the manner described by Mr. Peters, some five-ten minutes after switching on from cold. D6107 also failed, causing height shrinkage with top foldover.

The most obscure problem to date however was a tendency for the power supply to shut down (usually preceded by field collapse) and then immediately start up again. This would occur at intervals after about an hour from switching on, and seemed to be aggravated by thumping the back cover in the region of the line output transformer. I searched for dry-joints to no avail. For some reason, probably rage, I gave a sharp tap to the side of the large (small) signals panel and the fault revealed itself. The power supply started to switch on and off continuously and E1 appeared in the display. I could hear a faint clicking from the line output transformer and noticed a tiny flashover. Choke L5163 in the h.t. feed to the line output transformer was mounted very close to the transformer's body and was arcing across. Moving it sideways cured the problem.

I also have a Model 934 fitted with the KT3 chassis. This is six years old and is 100 per cent reliable. I would like to modify it to take a 1V p-p composite video input and would be interested in hearing from anyone who has done this.

John Wood,
John Wood Photography, Newcastle-upon-Tyne.

Editorial comment: Since the KT3 has a live chassis a mains isolating transformer would be required for a start. We would be happy to pass on or publish any comments from readers on the feasibility of this modification.

MAINS SUPPLY PROBLEMS

I am grateful to L. Hutchinson and Peter Chadwick for raising the important points in their letters in the June issue.

The advice concerning the repositioning of the anti-glitch capacitor to avoid supervisory tones blowing 50mA mains fuses was supplied in the first instance by the importer of the merchandise affected, and I cannot claim originality for it! Tones of quite large amplitude were used at the time. They could be heard in some appliances, like electric radiant heaters with a slack element that vibrated. The advice was given to the trade and presupposed a degree of common sense in the choice of fuse for the mains plug. Doubtless the practice is now falling into disuse as digital techniques take over.

In attempting to keep strictly to the point in my article in the April issue I unfortunately had to miss out reference to RCCB- and PME-type installations. In my experience the installation of an independent earth completely free from any connection to the water supply or the earth provided in the domestic electrical installation is fraught with problems. Whatever one does is relatively short lived. Burried copper plates corrode away in the soil and require frequent watering to remain efficient: even galvanised copper rots away eventually. My QL computer refuses to work for long on "raw" mains and has to be run either from batteries or a constant-voltage transformer.

The moral of course is that you must be careful with raw mains – I still keep one hand behind my back! Whenever there is any doubt about an installation the area Electricity Board should be consulted. They are usually very helpful. Sometimes an isolation transformer is required to make a completely safe installation. Often such a transformer is in itself sufficient to remove any unwanted garbage, though the cost is naturally greater than that of a filter.

J. LeJeune,
Nottingham

COMPUTER AS A SERVICING AID

I have been using a computer in my business for about five years now and have therefore been interested in the articles published recently in *Television* on the use of computers for storing service data.

In some cases the search for relevant information on the set that's being repaired can take as long as the repair itself, and is thus both time consuming and costly. The articles have referred mainly to the dBase II program, which runs on the IBM and its clones. This is complex – some of the command instructions must be frightening and seem almost gibberish to the beginner – and expensive unless you already own or use one of these machines and are familiar with its operation. All is not lost however. There are easier and cheaper database programs that will do almost as well on a more readily available home computer.

I use the well known and now very cheap Sinclair Spectrum computer, with an Opus Discovery disc drive. Any Spectrum will do (except the early "beige key version", issue one, which cannot be upgraded to 48K memory now as the bridge panel is no longer available). Spectrums may be found lying around unused or can be bought for around £40. The Opus disc drives cost around £80 if you can find one secondhand. Even new Spectrum Plus computers sell for only £70.

The database I use is Masterfile, by Campbell Systems. It will hold about 29,000 bytes of information. I use it as an index file with all the relevant data from your contents page plus the model(s) and number(s) of any sets referred to in the articles. I find that an index for a full volume (twelve issues) occupies around 24K, so there's room for extra "special references" to be added.

My method is to use the computer to search for the pages that refer to the set I'm working on in the volumes of *Television* and then select these copies from my collection of the magazines. I use three search routines: Title of article; Details of the first part (128 characters) of the contents' description; and Extra details, which covers the rest of the description. I use D for the most frequently used references to sets I service and E for the less frequently used items in TV Fault Finding, VCR Clinic, Service Bureau and similar articles, and from these three searches I can find all the articles in a particular volume in a very short time.

I can load any other volume index I've compiled from the Opus discs in about twelve seconds. It would take about three minutes from tape. So finding the articles takes quite a short time. There's not enough room in the Masterfile database for much technical data, but it's very easy to delete references that may not be used regularly and thus make extra room for such details as may be required. I've compiled full indexes for volumes 35 and 36 and would be prepared to supply copies of such data files on tape at £1·80 each, including VAT, post and packing, to anyone who already has the Masterfile program. If there's a demand for them I'll compile indexes for earlier volumes, and of course for volume 37 when this is complete. I would be prepared to give a fuller description of the way to modify the data and how I use the files. For example, since I service mainly Philips and Pye sets I went through the existing Master data files and eliminated the references I didn't need. I saved these as Philips 1, 2 and 3, then using a combined program I have for Masterfile datafiles I combined all these three into one. This would be possible for any make of set, and the Masters can be retained unharmed. It makes searching very much faster for the brands a dealer may handle. Anyone who has a Masterfile for the Spectrum could load the indexes from my tapes and use them straight away or modify them as required.

John H. Cowing, High Humbleton,
Wooler, Northumberland NE71 6SU.

A WORD OF WARNING

A few weeks ago someone planted a colour TV set full of old PCBs and rubbish, including a spring-terminated 6V battery, on my doorstep at around two o'clock in the morning. My dog barked but the clowns had gone. I've also had TV sets etc. left on my doorstep with a note attached saying please repair and I'll call in two days' time – sometimes a phone number is included. One of these sets was a joker. On taking the back off there was a microswitch stuck to the cabinet, with its button held in by the back cover. This was wired to a battery and a Veroboard with a 555 timer circuit and a buzzer. It was a bit of a surprise when this went off but thank goodness I'm here to tell you!

When I thought about this it reminded me of the hoax bomb made up of a water-filled balloon with batteries tied to it. This was found at the Christmas party in our local gay club disco. We got rid of it during a break in the festivities, but what if it had been a real bomb?

It seems that the targets of this sort of thing are mostly dance and disco and gay clubs. If you find one, get the battery out and treat the item as suspect. I try to help out repairing appliances, TV sets and so on belonging to fellow unemployed people. In conclusion, I'd urge readers to take care.

Ian Ruddock, G8NCZ,
Stanstead Abbotts, Herts.

next month in

TELEVISION

- **INTERFACING THE VM6101**
In the September 1985 issue Keith Cummins described the use of the Tifax XM11 decoder as a teletext adaptor for the Sony KV1820UB, showing how a set not originally designed for such use could be modified to give satisfactory teletext operation. Unfortunately, changes to the broadcast teletext signal since then have caused problems with the XM11 decoder, which was designed before the final teletext transmission standard was agreed. So Keith decided to redesign the adaptor project for use with the Philips/Mullard VM6101 decoder, using a programmed 8748 microcontroller chip to interface a modified XM11 type keypad with the VM6101. The exercise ended up giving very good results.

- **MAINS SUPPLY CHECKER**
The possibility of electrical shock from equipment connected to the mains supply is ever present, especially when a customer's supply has been incorrectly wired. Gordon Haigh describes a very simple plug-in checker, using just three neons, that enables you to see at a glance how the socket outlet has been wired. Something that field service engineers should find well worth carrying with them.

- **COAXIAL CABLE TV**
In the second part of his account of cable TV techniques J. LeJeune describes the planning of a coaxial distribution system and the vital passive hardware used for signal splitting, teeing off and tapping.

- **A LOOK AT SALORA SATELLITE RECEIVERS**
Time we thought to take a look at the signal processing in a representative satellite TV receiver unit. The Salora units provide a good example, with straightforward and easy to follow circuitry.

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TV Fault Finding

Reports from Aled Roberts, GW6BMP, D.A. Brown, Mick Dutton, Lawrence Ingram, Eugene Trundle, Roger Burchett, Hugh MacMullen, Michael Dranfield and Steve Leatherbarrow

Zanussi ZA374 Chassis

We fitted this set with a teletext adaptor kit. After doing so we found that no pages above 199 could be selected. Several days were spent testing, phoning and headscratching before the cause of the problem was found – the ITV text transmissions from certain transmitters were out of tolerance. The following procedure provided a cure:

(1) Switch the set on and select ITV text.
(2) Select mix.
(3) Ground pin 22 of CI1 (SAA5230). This will give the effect of weak sync.
(4) Adjust the crystal trimmer C28 until the text information begins to run from left to right across the screen – the text information should take approximately three seconds to run across the screen.
(5) Remove the ground link from pin 22 of CI1.

This adjustment cures the fault which is caused by a variation in the timing of the transmitted text signal and the inability of the crystal, because of its precise frequency, to cope with this variation. The crystal used in the latest teletext conversion kits has a wider bandwidth, so this fault should not occur. It's possible that a similar fault could be experienced with some Philips chassis that use a similar combination of CPU chip and crystal. **A.R.**

Mitsubishi CT2627

This new set suffered from height variations and occasional field collapse. The fault was very intermittent and the use of a hairdryer and freezer didn't help. We found that the problem lay with the field output transistors Q402 and Q403. Mitsubishi say that the output coupling capacitors C412 and C413 (both 330μF) should also be checked – their value is critical. **M.Du.**

NordMende FV Chassis

Set dead was the complaint. H.T. was present up to the anode of the flyback thyristor DU16 but there was no other life. A scope check showed that there was line drive output at pin 15 of line oscillator panel Z. There was also a waveform at the gate of DU16, but no other life. While we were working in this area the set suddenly came to life. The problem was traced to a dry-joint at one end of one of the line output stage tuning/coupling capacitors, CU16 (82nF). When we had resoldered this the set worked correctly, but after a few hours on test it failed. We had to replace DU16. **M.Du.**

Sharp C1415

This set had been dropped and the complaint was that the search tuning intermittently wouldn't work. We traced this to a crack in the print around the rear edge of the board, at the back of the tuner. **M.Du.**

Sanyo CTP5101

This elderly colour transportable came in with the complaint that the sound was o.k. but there was no picture. We checked the tube voltages and found that the grids were at 200V negative. This was because R617 (330kΩ) which provides bias from the first anode supply had gone open-circuit. When this resistor was replaced the set produced an excellent picture with the tube still in good condition. We also had to clean the push-button assembly and the line hold control. **M.Du.**

Etron EC142

This imported colour portable came in with the complaint that the tuning would intermittently drift off. The fault appeared on soak test and we found that a gentle tap on the front panel near the push-button unit would restore normal working. When we removed the front control panel the cause of the problem was obvious. Q700 in the 33V supply to the tuning presets had been soldered into the board and then twisted, with the result that its legs were intermittently shorting. Untwisting it cured the problem. **M.Du.**

Decca 80 Chassis

The complaint with this set was that it was dead. We switched on and found that the output from the power supply was correct. Our next suspect was the 5·1kΩ (or 6·8kΩ) line oscillator start-up supply resistor. This proved to be o.k. however. When we started to make voltage measurements around the TBA920 line oscillator chip we found that the set sprang to life when the meter was touched to either pin 3 or pin 4. Once it was working however the start-up resistor still got hot, with the 12V supply voltage low at 8V. The problem turned out to be that D302 (1N4148) was open-circuit. This diode provides isolation between the 12V rail and the line oscillator's start-up supply. **M.Du.**

ITT 80 Chassis

This fault had everyone baffled. The set produced a blank raster with a bright squiggle down the centre, like partial line collapse. The electronic tuning wouldn't tune either. The fault turned out to be due to the mains rectifier's reservoir capacitor C606 (220μF) which was open-circuit. As a result there was ripple on the h.t. line. **D.A.B.**

Fidelity ZX2000 Chassis

The TDA2581 chopper control chip and the chopper transistor were both faulty. These were replaced but no reason for their failure could be found – all the usual things were tested. We noticed that an enormous amount of lacquer had been applied to the set and when we switched on we found out why! Arcs flew everywhere from the top of the line output transformer. After replacing this there was no field scan as the TDA1170S chip had failed, then no colour because of another faulty chip (TDA1365). **L.I.**

Sony BT871 Tuner

The BT871 u.h.f. tuner is used in several older Sony CTV models including the KV1400 and KV1810 – it's the long narrow one with quasi-phono sockets for the signal input

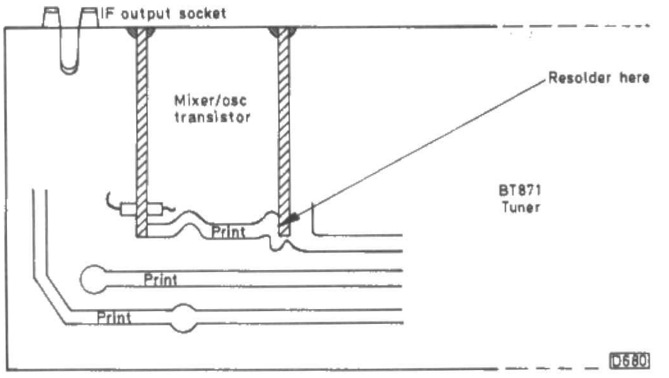

Fig. 1: Trouble spot in the Sony BT871 tuner.

and output. We've had several examples that have suffered from intermittent tuning drift which can usually (but not always!) be instigated by tapping or squeezing the tuner. The cause has in all cases been a bad joint between the earth print land and the screening wall on the r.f. side of the mixer/oscillator compartment. Fig. 1 shows the trouble spot. **E.T.**

Rank T22 Chassis

This set came in with a leaky BU208A line output transistor. After checking for other faults the BU208A was replaced and the set was put on soak test for a couple of hours. A few days later it was back with the same fault. This time we discovered that someone had fitted a 1·5Ω instead of a 1Ω resistor (5R8) in series with the BU208A's base. Assuming that this was the cause of the trouble we replaced 5R8 and the BU208A. This time the BU208A lasted for only a few seconds. Careful examination of the BU208A's base circuit revealed a dry-joint at pin 3 of the line driver transformer. Resoldering this and fitting yet another BU208A produced a good picture and no further trouble. **M.D.**

Sharp DV1600

This set would intermittently go into the standby mode. Due to the intermittent nature of the fault it took us a long time to discover the cause. Once it had gone into standby, which could take anything from three hours to three weeks, the set couldn't be switched back on unless it was allowed to cool for about an hour. The last time it went into standby repeated switching on and off gave the fault away – there was a vertical line from top to bottom (line collapse). Now the line scan coils are connected to the collector of the 2SD869 line output transistor via a bolt which is soldered to the print: the other bolt that secures the transistor is connected to the line output transformer. A circular ring (dry-joint) was noticed round the former bolt. This was the cause of the fault and after resoldering with a 140W gun to provide a good solid joint there was no further trouble. **M.D.**

Thorn 9600 Chassis

This set had no sound or picture, though e.h.t. was present. When we made a quick check on the power supplies we found that the 34V supply was missing, with F511 (500mA) open-circuit. An ohmmeter check from the fuseholder to chassis showed a dead short which was traced to C171 (6·8μF) on the decoder panel. After replacing this item and the fuse the set was found to be tripping. This time the 34V rail was a good 10V low at 24V. The cause was traced to the 24V regulator transistor VT812 which was short-circuit collector-to-emitter. When this had been replaced normal working was restored. **M.D.**

Rank T20 Chassis

I still get these sets with a BU208 fitted instead of a BU208A. This one was starting up and there was plenty of audio noise. Occasionally a channel could be tuned in. The h.t. voltage was varying wildly around 110V instead of being steady at 200V and there was no e.h.t. of course. The BU208 had developed leaks between all three connections. The owner swore that the set had had only a replacement on-off control. Oh yes, and they'd been having trouble with the line collapsing. Another fine burn up you've got me into Stanley! **R.B.**

Murphy V1400

No field scan on this Hitachi-looking set was due to C408 (1μF) being open-circuit. **R.B.**

Rediffusion Mk. 3 Chassis

The problem with one of these sets was low, distorted sound which at first was intermittent. Replacing the audio driver transistor's load resistor 0R71 (820Ω) provided a cure – use a 1W resistor in this position. Another of these sets had washed-out video, with the contrast and brightness controls inoperative. The cause was the chroma demodulator chip 2IC1 (MR1327P). **R.B.**

Pye 731 Series Chassis

The fault with this set was no green. The usual voltage checks were made and the resistances in the circuit appeared to be within normal tolerances. I noted however that the TBA530 matrixing chip's green output load resistor R458 was about 43kΩ instead of 39kΩ, and to my amazement found that the relevant part of the chip shuts down when the load resistor value exceeds about 42kΩ, thereby switching off the output transistor. **H.MacM.**

Grundig GCS 100/200 Chassis

The fusible resistor R607 would open now and then. I eventually found that the cause was that old favourite with the G8 and G11 chassis – the insulating pad under thyristor Ty501 sometimes read about 500Ω to chassis. **H.MacM.**

GEC C1407H

The fault with this set was no colour and weak contrast, with all three controls (colour, volume and brightness) doing very little. We went about this in rather the wrong way, by checking the voltages around the single chip decoder. No significant errors were found and the sandcastle pulse was present. A helpful GEC technical representative suggested a careful check on the shape and amplitude of this pulse as the decoder chip does odd things if this is even mildly incorrect. The pulse was correct however and after further investigation we found that the 12V supply to the controls was missing due to a hairline crack. Isn't it strange how you can convince yourself that a fault is going to be a pig even before you start, then you lead yourself up the garden path! **S.L.**

Servicing Mechanical VCRs

Part 5

Mike Phelan

In the last instalment (June issue) we looked at the rather horrendous but clever part of the mechanism whose sole function is to make the drive arm move one way when play, record or audio dub is selected and return it when stop is selected. The bulk of the mechanics below the deck are concerned with this operation and don't cause too many problems.

The drive arm is the prime mover for the loading arms and for the first part of the pinch roller's travel, before the solenoid takes over. Subordinate functions are: moving the loading arm lock levers which operate the "stoppers" that hold the guide rollers and slant poles firmly in position; releasing the reel brakes; allowing the back-tension device to engage; and moving the take-up clutch into position.

All the electrical functions are carried out by the row of microswitches above the keys, the UL and AL switches on the deck, and the two slide switches on the audio/servo or audio only (3V16) board. The first two of the above groups mainly switch supply rails: the slide switches are concerned with audio and erase switching. Control of much of the servo and signal circuitry is achieved by switching supply rails.

Loading Arm Mechanism

We'll start this month with the loading arm mechanism. Movement is initiated by a pin on the slide plate: it engages with a slot in the drive arm – see Fig. 1. The adjustable link at the other end of the slide plate moves the rotary lever and its two attached links which move the loading arms into position. At the completion of loading a wire link from the rotary lever partially rotates the tension cam: a projection on this passes up through a slot in the deck. This projection releases the back-tension arm from its parked position, allowing the pole to contact the tape. The back-tension device is in fact a mechanical servo: the brake is pulled off if the tape tension increases.

The drive arm also operates the loading arm lock levers. Primarily (see Fig. 2) these move the two lock arms into position during the final part of the loading cycle. These lock arms carry the alloy impedance rollers (plastic on the Mk. III deck), also the stoppers that lock the slant pole/guide roller assemblies (see Fig. 3) in position. The lock arm on the supply side also carries the full erase head. A projection on the loading arm lock lever on the take-up side moves the pinch roller slide plate (see Fig. 2) which brings the pinch roller into the pause position, releases the reel brakes, and engages the take-up clutch.

It's useful to study the detailed operation of the slant pole/guide roller assemblies as they tend to cause problems in ageing machines. Each assembly consists of a cast base into which a slant pole is pressed and a guide roller is screwed, the latter being locked with a setscrew – see Fig. 3(a). The guide roller has a plastic centre section which should rotate freely on the metal pin. The guide rollers are vertical, but the slant poles incline in opposite directions. The only other item in the slant pole base is a steel pin that engages in a notch in the locating block (part of the drum base). This determines the height of the assembly when loaded. The slant poles also locate in a pair of V notches in each block, giving registration in the horizontal plane.

An angle bracket to carry the slant pole base is screwed on to the end of the loading arm. The base is not rigidly attached to this – it's allowed considerable freedom of movement. This is achieved by means of a screw with an integral spacer and an enlarged hole for the bracket. The purpose of this arrangement is to allow the base to be located purely by the pin and slant pole without the loading arm having any influence on its position. Furthermore, although the angle brackets are firmly screwed to the loading arms the holes are large enough to allow adjustment.

During the loading cycle, once the loading arms are in position the lock arms move forwards and the stoppers engage the guide rollers, holding each assembly rigidly. It's important that the stoppers don't play any part in moving the loading arms into position. If, through misadjustment, this happens the guide rollers and slant poles cannot be rigid.

Problems

The problems that occur are many, and are often increased by previous unskilled repairs. The loading arms and associated parts are critical as they determine the path of the tape.

Probably the most common problem is caused by the method of driving the loading arms. They are both propelled forwards by adjustable links attached to the rotary lever. That on the take-up side has a peg which projects down through a curved slot to take the link. This peg occasionally becomes loose, requiring rerivetting or replacement of the loading arm. The supply loading arm is moved by a short arm which is attached to its pivot by a single screw. The pivot has two flats to locate the short arm. If the screw works loose the flats wear and the hole in the short arm gets chewed up. The cure is to replace both components. See Fig. 4 for details of this trouble spot. To check for this problem, press play with the machine switched off, then turn the flywheel until the machine is half loaded. Grasp the right-hand (supply) loading arm and check for excessive movement in the direction of travel.

It's important that the loading arm pivots are free and lubricated – they sometimes seize up due to corrosion of the plating. Unfortunately they have to be dismantled to lubricate them – this requires removal of the lower drum assembly. A useful tip here is to unplug the pre-rec board instead of unsoldering the rotary transformer leads, then remove the board and lower drum as a unit.

Tape path errors caused by the loading mechanism require careful observation while the flywheel is being turned by hand. The pole/roller bases must not foul the deck or drum base, and they must be free to locate in the notches without being forced one way or the other. If the latter occurs the angle bracket is probably bent or misplaced. Slacken the screws, load, then tighten. Both bases

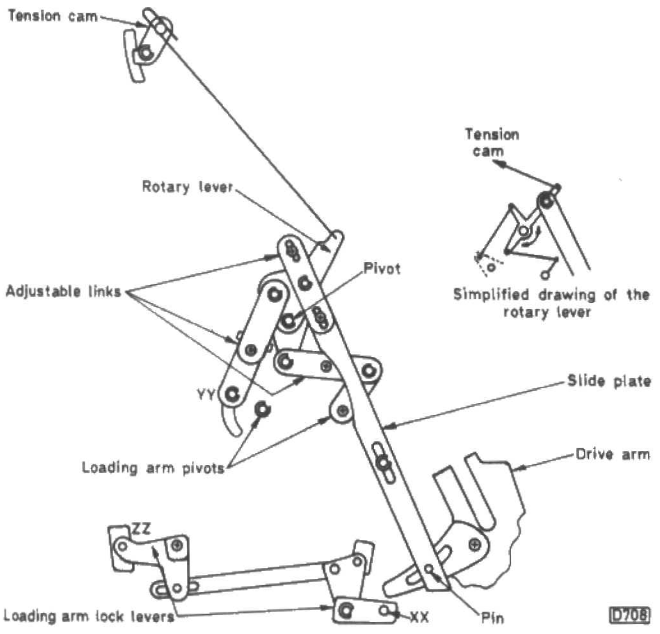

Fig. 1: Loading arm drive system.

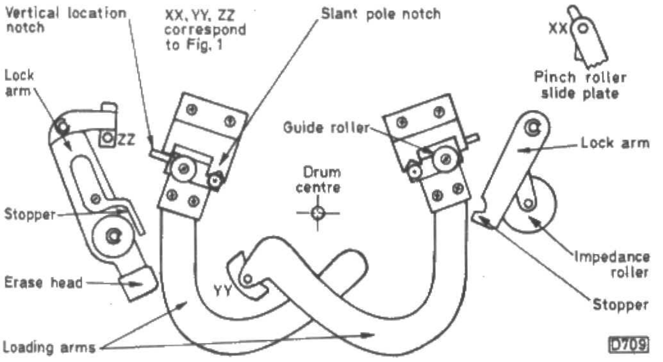

Fig. 2: Simplified diagram showing the loading arms in the almost fully loaded position.

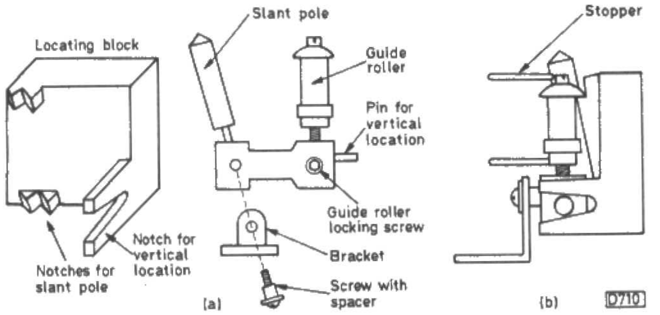

Fig. 3: (a) Details of the right-hand slant pole/guide assembly and the left-hand side opposite angle. (b) Cross section when in the loaded position.

must reach the loaded positions simultaneously. If one gets home first either the flats on the supply arm are worn or the adjustable links have been altered.

It's sometimes easier to check the movement of the loading arms after removing the slide plate, but note the positions of the polythene washers.

The back-tension cam doesn't give any trouble, but if anything is sticking here the back-tension pole can remain outside the tape loop, causing incomplete tape wrap. The result is that in the record mode approximately a third of a previously recorded picture remains – this produces a very wide noise bar on playback.

The pinch roller slide plate can get stuck to the deck plate with spillage, causing sluggish action.

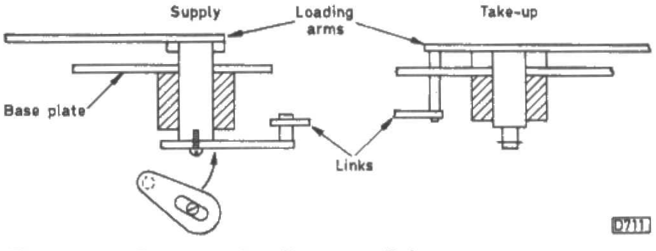

Fig. 4: Details of the loading arm links.

The loading arm stoppers should contact the guide rollers squarely: watch out for misplaced erase head wiring that prevents this.

A fairly common fault with several causes is the intermittent appearance of a noise bar at the top or bottom. It can be cleared by adjusting the guide roller(s) but reappears in time. The most common cause is that the setscrew on the guide roller is loose. If it's not slackened before adjustment the thread will be damaged. Slacken only sufficiently to allow the roller to be moved – if it's too loose the tape motion can disturb the adjustment before you tighten up. The same symptom can be caused by anything that prevents positive location of the pole/roller base assembly. One reason for this can be a burr on the notch that takes the pin. Another is foreign matter compressed into the same notch. Don't forget about the drive arm lock roller (see previous instalment). If this jumps out at the completion of loading the loading arms can move back imperceptibly.

Don't alter the positions of the two locating blocks. This is no consolation if someone else has! All you can do in this case is to hope that the locking paint gives a clue to the original positions.

It goes without saying that parts such as the slant poles, guide rollers and impedance rollers should be smooth and undamaged. The same applies to the full erase head, whose surface is rather brittle and easily damaged.

Reel Assemblies

There are not too many problems when it comes to the reel assemblies. The height of the reel discs, which is adjusted with shims, is not too critical, but the discs are prone to seizing on their pins, especially with the Mk. III deck. Note that the Mk. III uses plastic rings in place of circlips to retain some parts, including the reel discs.

All rubber tyres require replacement periodically. The first one to wear out is that on the take-up reel. It becomes glazed and slips instead of the clutch slipping. The result is a squeak on record and playback.

The take-up clutch is the real villain of the piece here. The felt friction washers become polished and the clutch then slips, driving the tape erratically but sufficiently to chew it up before the Hall sensor operates and stops the tape transport. The Mk. III version is better in this respect. Replacement is the only cure.

The unloading and reel idlers, and indeed the clutch, are prone to seizing up due to fluff winding itself around the spindles, but the first two give little trouble otherwise.

A loud screech on fast forward or rewind should direct attention to the counter pulley which loses its lubricant after a while. If it seizes up the machine trips out. This can be very intermittent and baffling – the clue is to watch the counter closely. A drop of oil suffices.

The brake mechanism gives little trouble if kept clean and lubricated. Check that the unloading operation does indeed wind the tape back into the cassette – a fault here can be missed.

Back-tension Band

The back-tension band needs replacement periodically, and the back tension must then be readjusted. If a gauge is not available, a rough and ready way is to set it so that in playback the right-hand impedance roller is just moving and the back-tension lever is at about half travel. If the back-tension arm moves about considerably during playback, suspect a faulty pinch roller or take-up clutch or tyre – but try another tape first.

To Follow

In the final article in this series we'll talk about the key assembly and any other odds and ends that have not so far been discussed.

Vintage TV: Early GEC Receivers

Chas E. Miller

GEC and Sobell were part and parcel of the same group for so many years that it's difficult to recall the early days when the companies were separate and GEC produced some highly individual designs of its own. GEC is in fact one of the oldest names in the industry, its radio sets dating back to the earliest days of broadcasting. Sobell came along rather later, at the end of the second World War, and quickly gained a reputation for reliability – as evidenced by the unprecedented length of its guarantees. When the merger took place, in the early sixties, it was the latter company's designs that survived. The name GEC became yet another badge engineering job.

GEC had been in on television from an early stage, and at this point I must shamefacedly admit that many years ago I let one of their pre-war models slip through my hands. This was on the celebrated occasion (recorded in this column some time ago) when I had the job of clearing out a radio and TV shop's stockroom above a cinema in Newcastle-under-Lyme. There were two old TV sets amongst the spoils, one being a 5in. Marconiphone and the other a monumental GEC which in a moment of incautious generosity I gave to one of my erstwhile assistants. So, Gerald Horrox, if you read these words . . .

The BT1091B

I must start therefore with the first post-war GEC set I encountered, a 9in. table model known as the BT1091B. Its moulded cabinet held a large, single-deck chassis that carried 21 valves and the c.r.t. A two-screw quick-release system was fitted to make service access easy. Considering the general design of TV sets at around this time (the BT1091B was released in August 1949) the GEC set was refreshingly sensible and straightforward.

The receiver section was of the superhet type, using mostly Z77 miniature r.f. pentodes, but oddly enough an octal-based L63 triode was used as the local oscillator. The sound i.f. was extracted in the Z77 mixer pentode's anode circuit via a trap, there being no common vision/sound i.f. amplifier stage. There were two vision i.f. amplifier valves followed by a diode demodulator (half a D77) whose output was passed to yet another Z77 which was used as the video amplifier. This stage was interesting (see Fig. 1) since it was an early example of what was to become quite common practice, the use of h.t.-derived standing cathode bias to improve the stability and overall frequency response of the stage.

The c.r.t. was driven at its cathode, the other half of the previously mentioned D77 acting as an interference limiter. Four preset clipping levels were available by altering shorting links across the resistors in the D77's anode circuit. The interference limiter in the sound channel was unusual, employing both sections of another D77 in a negative feedback arrangement that muted the first a.f. amplifier stage (DH77) in the presence of short-duration interference pulses. Younger readers, reared on 625-line TV, might well wonder what all the fuss was about. With the modulation system used for 405-line transmissions the receivers were very vulnerable to impulsive interference, especially from motor vehicles. This could result in large white splashes on the screen, accompanied by a machine-gun effect from the loudspeaker. In the days before the compulsary fitting of interference suppressors the BBC used to put out a short film designed to press home the need for them. An irate viewer, unable to stand the annoyance caused by a nearby car any longer, hurled a brick at his TV screen whereupon the set, and the car, both went up in two glorious bangs! The car, by the way, was an old Austin Seven, which would now be worth thousands of pounds. I wonder if they really did blow it up?

The sound output was from a KT61, a large octal-based "kinkless tetrode" capable of providing 4·3W as a class A amplifier. Another of these valves was used in the field output stage, but was in this case triode connected. It worked as a multivibrator in conjunction with an L63 triode, and had transformer coupling to the low-resistance scan coils. Both the height and linearity (referred to as "form") controls were in its cathode circuit, consisting of 1kΩ and 10kΩ potentiometers respectively.

The line timebase circuitry was unusual enough to deserve illustration (see Fig. 2). An L63 was used as a line sync pulse inverter whose output pulses were coupled to another L63 via the secondary winding on the line output transformer and C56. The line output valve was a Mullard EL38 output pentode, which must have been a bitter pill for the designers who would no doubt have much preferred to stick with GEC valves, but an equivalent type was not available. The L63 and EL38 acted together as a multivibrator, the drive waveform being generated across C57. At the end of the scan there was feedback via the line sync pulse path. Wonder of wonders, flyback e.h.t. was used, provided by an overwinding on the transformer and a U37 soldered-in rectifier. The nominal e.h.t. voltage was 6·5V.

Focusing was provided by means of an electromagnet which was fed from a negative supply derived from the centre tap on the mains transformer's secondary winding. This supply was bypassed by a variable resistor. The current through the coil was of the order of 150mA, the voltage being between 28-37V. Normal h.t. was supplied by a pair of MU14 rectifiers, each rated at 120mA and

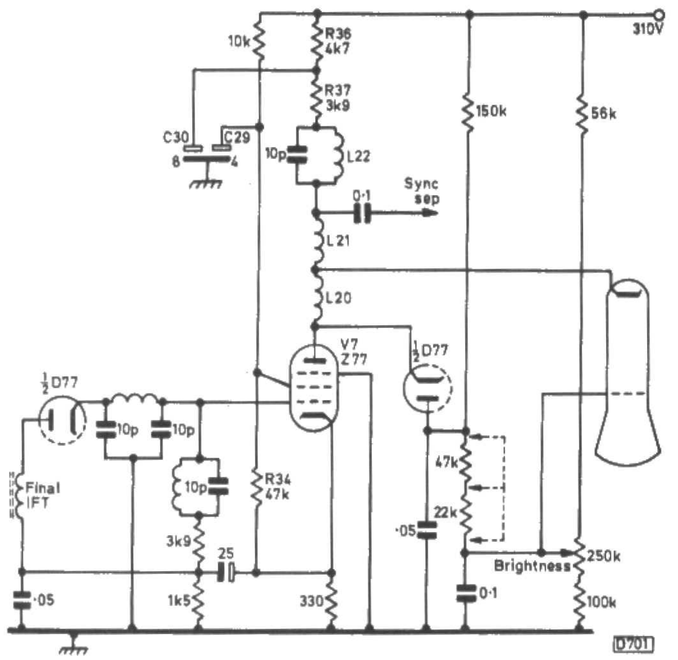

Fig. 1: The video circuitry used in Model BT1091B. Much work had gone into the design of the video output stage. Note the bias stabilising by means of R34 and the use of both series (L20) and shunt (L21/22) h.f. peaking coils. As a result of partial decoupling (C29) there is l.f. negative feedback at V7's screen grid while at very low frequencies R36 is added to V7's anode load due to partial decoupling by C30.

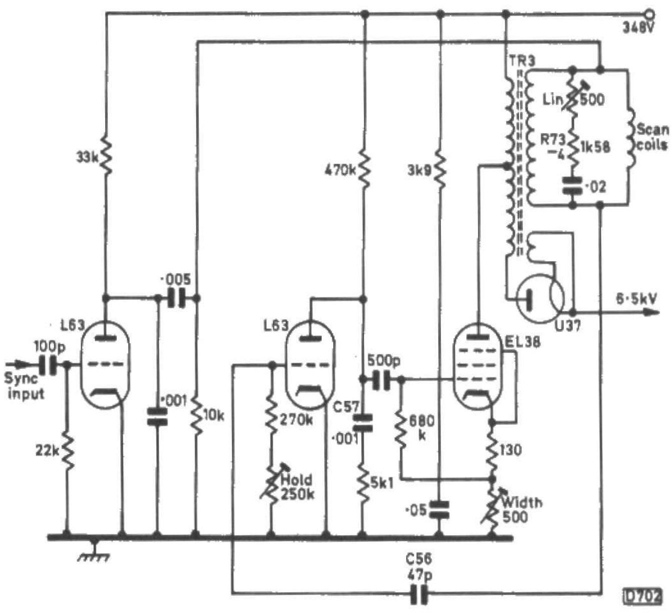

Fig. 2: The line timebase circuit used in Model BT1091B, an early example of the use of the output stage as part of a multivibrator circuit.

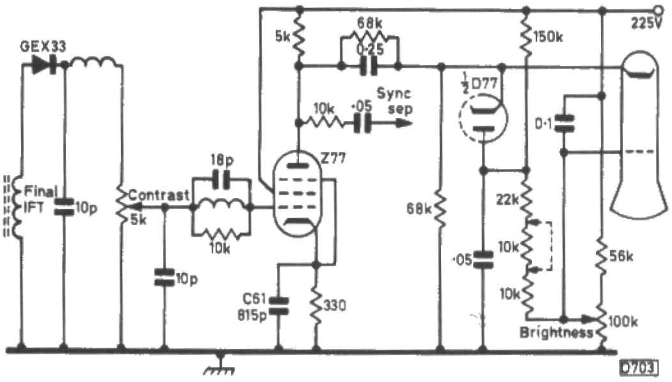

Fig. 3: The video circuitry used in Model BT2147. This time an RC l.f. attenuating network was incorporated in the feed to the c.r.t. cathode. C61 was 1·5kp in Midlands sets.

delivering 348V after smoothing. The mains transformer was of the fully isolated type, and an obscure feature was the provision of a separate l.t. winding for the D77 sound interference limiter valve. Although this valve had a heater voltage rating of 6·3V the winding supplied only 5·8V and was centre-tapped, the centre tap being connected to the focus coil's supply. Possibly a portion of this supply was used as bias for the valve.

The BT2147

In July 1950 the BT2147 made its appearance. This was a compact 9in. table model in a plastic cabinet. It was an excellent set with an advanced design for the period, but it tends to have been forgotten compared to the similar but more famous Bush TV12. GEC marketed models for London and Birmingham, the only difference being the detachable r.f. unit which made it easy to convert a set for use in a different area.

For some inexplicable reason the earlier superhet design was abandoned in favour of a t.r.f. receiver, but the rest of the circuitry took on a more modern appearance. There were on fewer than four vision r.f. amplifiers, again the redoubtable Z77s, three of them being common to the sound channel. A crystal diode was used as the vision demodulator, with the contrast control as its cathode load (see Fig. 3). The wiper of this control was d.c. coupled to the video amplifier valve's control grid (a Z77 again). This time the video amplifier had a single low-value resistor (5kΩ) as its anode load and its screen grid was connected directly to the h.t. line, with no decoupling. Half the inevitable D77 was used as an interference limiter, the other half being used as an interlace filter for the field sync pulses.

A B36 double triode did duty as the blocking oscillator in both timebases. The line output stage now used a boost diode, but the voltage gain thus obtained was by no means as great as that in later designs. Once again a U37 provided the e.h.t., now 7kV. Marconi-Osram (the valve company jointly owned by GEC and EMI) had by now produced its own line output valve, the KT36, which was used here.

A permanent magent was used to focus the c.r.t. Normal h.t. came from a metal rectifier in a conventional a.c./d.c. circuit, and all the heaters were series operated. Voltage tappings were provided for mains inputs of 200-250V, with part of the rectifier being shorted out on the lower d.c. ranges.

A single separate sound r.f. amplifier had its output demodulated by the diodes in a DH77 which was followed by a much simpler crystal diode interference limiter circuit. N37 miniature output pentodes were used in both the audio and field output stages.

Later versions of this set had a superhet receiver unit which was tunable to all the Band I channels. I remember buying one of these from a customer, at a nominal price, more or less to do him a good turn. I casually asked what was wrong with it, and received the reply that "Mr. Blank (a well known local dealer) said the tube had gone and it wasn't worth repairing". The set had been sent in for field collapse! It was far from being the first time that I'd come across this sort of thing in connection with Mr. Blank, but as always it was hardly worth persuing the matter. The fault was in fact due to an open-circuit blocking oscillator transformer, and when this was repaired the set gave an excellent picture.

A Portable Conversion

This was in the days before portable TV sets were generally available, the sole example at the time being the Ekco TMB272. The little GEC set seemed a suitable candidate for a conversion job. I fitted a 13-channel tuner and wired all the valve heaters for series-parallel 12V operation, replacing such valve types as necessary with 6·3V equivalents. The line output valve was changed from a KT36 to an EL81 for example, and the U31 boost diode was changed to an EY81. H.T. was provided by an external vibrator power pack obtained from an ex-government surplus store and intended for use with the No. 19 tank set. The results were excellent, the sensitivity being more than adequate for most areas even with a short rod aerial. But I didn't enjoy them for long. The set was seen by a long-distance lorry driver who was so impressed that he made me an immediate, non-refusable offer. I often wonder what became of that set, for I never saw it again. The battery drain was fairly high – around 6-7A as I recall – but this would have been of little account with a heavy-duty lorry battery.

Later GEC Models

GEC stayed with the removable r.f. chassis idea for many years. In fact the basic design of GEC chassis varied little during the following years, apart from the fact that the timebase chassis was changed to vertical mounting. For a time the mains dropper resistor was replaced with a barretter, which was fine for dealing with mains variations but became difficult to obtain when it failed.

An ingenious converter was produced for use when ITV came along. It consisted of a plinth about four inches deep to house the tuner unit. This assembly was screwed to the bottom of the original cabinet. The selector switch was in a convenient place, central beneath the tube, and there was no need for elaborate drilling and fixing. These converters were difficult to obtain at one time, causing customers who had seen "Snow White and the Seven Dwarfs" to comment "some time my plinth will come", which proves that what this column may lack in class it makes up for in sheer nerve. Seriously though, the tuner was of the incremental type, having one Band I and two Band III positions. Since each channel had its own separate adjustments, it was possible to peak them up if need be to obtain extra gain at the expense of bandwidth. GEC used this type of tuner for a number of years, the performance being perfectly adequate as regards the choice of channels.

When 110° c.r.t.s appeared towards the end of the fifties GEC brought out its famous bow-fronted range, which had two vertical chassis and a twelve-position turret tuner. The line output stage was mounted horizontally beneath the tube, between the two receiver and timebase sections. Various versions of this basic layout took the company into the sixties and thence to the time of the merger with Sobell.

A Look at Capacitors

George Wilding

Probably the least understood, though important and often referred to, expression in electronics is that "capacitor current leads the voltage by 90°", i.e. the current flowing is at maximum when the voltage is starting to rise from zero and vice versa (see Fig. 1). This gives rise to the question "how does the current know what the voltage is going to be?" Capacitive current is given by the expression V/Xc, where Xc is the capacitive reactance or the capacitor's opposition to a.c., but this doesn't get us very far. In textbooks Xc is given as $1/2\pi fC$ where f is the frequency and C the capacitance in Farads (so 1,000,000 must be placed above the line for μF calculations). Thus the reactance of an 0·01μF mains filter capacitor to the 50Hz supply is roughly 8kΩ, and 0·03A will seemingly be taken by the capacitor though it won't affect the supply meter. At the other end of the scale an 0·01μF capacitor will have a reactance of some 16Ω at 1MHz, and by simple proportion the reactance of other capacitor values at other frequencies can be determined.

It's easy to appreciate that the current in an inductor lags 90° behind the applied voltage, since the application of d.c. to a coil induces an equal but opposing e.m.f. at switch on when the current is zero, rising at a rate dictated by the LR values until finally, when the counter e.m.f. is minimal, the current is at maximum and is dictated by the voltage applied across the coil's resistance. To a.c. voltages of course $I = V/Xl$, where Xl is the inductive reactance or $2\pi fL$.

Thus only a switch-on pulse is needed for the line output transistor to initiate the rise of current though the highly inductive combination of the line output transformer's primary winding and the line scan coils, this current rise being limited, for scanning purposes, to the initial and most linear portion of the current curve. As the field frequency is only about a third of one per cent of the line frequency the loading presented by the scan coils is predominantly resistive, with only a small reactive component. Thus to obtain a sawtooth current rise we must apply a sawtooth input to the output transistor(s). Therein lies the reason for the totally different approaches re-

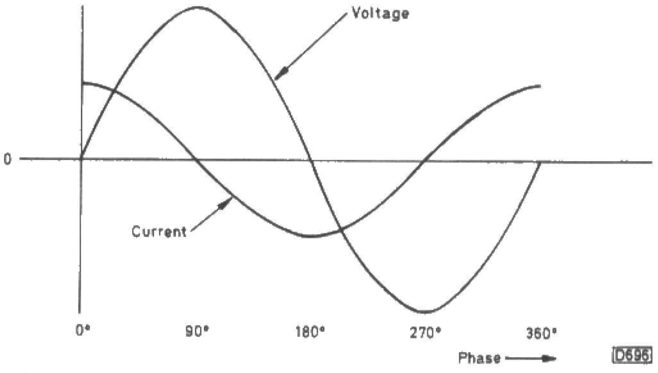

Fig. 1: Capacitor current-voltage characteristic – current leads the voltage by 90°. Because the voltage rate-of-change is at maximum when it crosses the zero line, though the instantaneous voltage is zero the resulting charge/discharge current flow is then also at maximum.

quired to field and line output stage design.

Back now to the capacitive *VI* relationship. Consider first a battery shunted by a crowbar. The terminal voltage across such an almost perfect short will be minimal, but the current will be at maximum, with virtually all the battery's e.m.f. being developed across its internal resistance. The power output, being the product of *V* and *I*, will also be zero – since *V* is zero. Similarly, at the instant when a capacitor is connected across a d.c. supply source the voltage will be reduced to zero, subsequently rising in the usual manner to the initial supply voltage. Again we have the situation where zero voltage occurs at the same time as maximum current flow.

Turning now to the application of a capacitor in an a.c. circuit, consider the situation when the applied voltage waveform is falling in amplitude and is approaching zero – refer to Fig. 1 again. This rapidly changing voltage coincides with a high current flow that reaches a momentary peak when the voltage rate-of-change is at maximum. This is the point where the instantaneous voltage is zero, and the current is reversing from the peak charging rate in one direction to the peak discharge rate in the other direction. Later, when the voltage reaches its peak value, the current is simultaneously at zero – there is no longer any charge or discharge current.

Power Factor

We can now see why capacitive current is termed wattless: the charge a capacitor accepts when the voltage is rising is returned to the supply when the voltage is falling. To a series connected ammeter however this current ebb and flow, constantly reversing in polarity, produces the same reading as the true current flow through a resistor of equal value to the capacitor's *Xc*. Clearly then when measuring a.c. power we must include another factor in addition to *V* and *I*, to allow for the phase relationship between these two. This is called the power factor, and ranges from zero in a purely capacitive or inductive circuit, when the phase relationship is 90° (as shown in Fig. 1), to unity in a purely resistive circuit when *V* and *I* are in phase. Power factor is expressed as cos ϕ, *R*/*Z* or true watts/apparent watts.

The aim of the power supply engineer is naturally to keep the power factor as close as possible to unity, for the "wattless" current of a pure capacitor or inductor will still cause a power loss when passing through the resistance of the power supply cables etc. The "goodness" of high-value, high-voltage capacitors is sometimes expressed in terms of power factor, thus covering both shunt leakage and series resistance losses.

Capacitor Uses

In the component lists contained in manuals capacitors will, if their purpose in the circuit is given, be described variously as reservoir, smoother, filter, coupler, decoupler, pulse shaping, tuning, ramp generation and so on. Whatever their use, the end result depends on the ability of a capacitor to hold a charge, offer an apparent current flow path to a.c. or fulfill both functions at once.

Thus while the reservoir capacitor in a mains rectifier circuit must take up sufficient charge during the rectifier diode's conductive periods to maintain a reasonably level voltage during the rectifier's non-conductive periods, the associated smoothing capacitor must provide a low reactance path to the 50 or 100Hz ripple and act as the power supply source for the following circuitry. Obviously the effectiveness of this reactance is improved by increasing the value of the series resistor in such a circuit, so that this component develops across it most of the ripple.

With switch-mode power supply circuits that operate at a much higher frequency the values of the reservoir and smoothing capacitors used can of course be drastically reduced while still maintaining the same level of smoothing. This arises because for the reservoir capacitor the time between the charging pulses is very much shorter, while the high ripple frequency means that the smoothing capacitor's reactance is reduced in direct proportion.

The capacitive reactance required in any application is largely determined by the circuit resistance or impedance. Thus to filter out the residual i.f. from a video signal applied to an emitter-follower stage with an input impedance of about 100kΩ the reactance of the shunt filter capacitor must be a fraction of this value – but not so low that it would offer a relatively low reactance path to the higher video frequencies. With the i.f. at 39·5MHz and the top video frequency at 5·5MHz, giving a ratio of just over 7:1, the optimum value is fairly critical. In practice therefore a series choke would be used with a shunt capacitor to form a low-pass filter. Whatever value capacitor is decided upon will have negligible effect if it's connected across the emitter load resistor. This arises because the value of the load resistor is only a fraction of the input resistance. For this reason emitter-follower stages are widely used following the detector in discrete component circuitry.

Similarly, a stray capacitance of say 100pF across the 12kΩ or 15kΩ load resistor in an RGB output stage will produce more h.f. attenuation than 100pF across the stage's 1kΩ or 2kΩ input impedance.

Decoupling

Everything depends on capacitive reactance values in relation to circuit impedance or resistance. To be at all effective the reactance of the capacitor shunting an emitter resistor must be a fraction of the resistor's value – ten per cent is the accepted figure.

Thus for i.f. and chroma amplifier stages only small capacitors are needed while for complete emitter decoupling of an audio or field output transistor an electrolytic type is called for.

With RGB output transistors and the video output transistors used in monochrome portables only partial emitter decoupling is employed. This is done to linearise the frequency response. Due to the increasing effect of the load shunt capacitance towards the top end of the spectrum the gain tends to fall off. By using a small-value emitter decoupling capacitor the stage gain is maintained at the higher frequencies but, due to increasing negative feedback, decreases as the frequency is reduced, thus maintaining a linear overall frequency response. By careful choice of *RC* values, with often more than one *RC* combination, the stage gain can be tailored to yield optimum performance.

Without any emitter decoupling the base-to-chassis voltage applied as the input to a transistor is reduced by the oppositely phased waveform developed across the emitter resistor – these two waveforms are effectively in series opposition. For full decoupling, the capacitor should charge as the emitter current rises, the charge being returned as the emitter current falls. In this way the voltage change across the parallel emitter *RC* pair is minimised and the base-to-chassis input is almost wholly developed across the transistor's base-emitter junction.

Cable Television Techniques

Part 1

J. LeJeune

"Cable television" is a general term used to describe the distribution of primarily TV signals over a closed-circuit network – as opposed to radiating the signals so that anyone can pick them up via a suitable aerial. The term is applied to a variety of systems from a small community-aerial installation serving a block of flats to the mammoth multi-channel networks that cover whole towns and cities both here in the UK and abroad. Within the cable TV fraternity the preferred term for a small communal system is MATV, or "master aerial television", while large networks fall into the category of CATV, which has been variously defined as "community aerial television" or "coaxial television" – the latter term excludes of course the large number of multi-pair networks that don't use coaxial cable, so the all-embracing term "cable television" is most appropriate here.

Having established the basic terminology we should next consider the reasons for installing a cable television system. Today cable distribution may be adopted for any of the following four reasons – or a combination of the four. (1) To provide signals where reception is difficult or impossible due to site geography. (2) To allow a single array to be shared by a number of receivers in an attempt to prevent a mass afforestation of aerials. (3) To provide additional channels to those available off-air, as a commercial undertaking, using the closed nature of the network to prevent piracy of the signals. A charge is made for receiving such a service. (4) To provide an integrated communications network, with two-way traffic to allow viewer participation, and normal telephone and data transmission within the area covered by the network. Aims (3) and (4) can include the provision of a local TV channel for local news etc.

Radio Relay

These latter arrangements are a long way from a simple MATV system, and this is in turn a long road from the humble beginnings of cable TV. In fact cable distribution of signals began in the early days of wireless, when there was but one programme and radio sets were expensive and beyond the means of many people. In those days it was usual to have a d.c. mains supply and it was a relatively simple matter to superimpose on the supply an audio signal that could be picked off at the terminal unit by means of a capacitor, with chokes to isolate the audio from the appliances used in the house. This "radio relay" system brought the pleasures of wireless to many who could not afford a radio set, for the installation was cheap – just a loudspeaker with a transformer, a switch and a volume control. Commutator ripple from the generators at the local power station was a problem, and when more than one radio programme became available this method soon fell into disuse, helped by the widespread conversion to a.c. supplies.

Subsequently audio networks sprang up in towns where the population density was sufficient to warrant the cost of installing distribution cables. Various names were used for them – radio relay, wireless relay and wired wireless were amongst the most popular, though use of the word wireless was a terrible misnomer. Open pairs were used, carried on porcelain "dollies" in a similar fashion to the telephone wires of the same era. A pair of wires was required for each programme carried. The audio signals were distributed at high level from the receiving station: a power of 1kW into 600Ω was common, giving an r.m.s. voltage of approximately 800V!

For obvious reasons such a high level was not practicable for direct subscriber connection. The power of the trunk lines was stepped down for local distribution purposes, using bridging transformers that preserved the balance and impedance matching of the trunk lines. The directional properties of the bridging transformer prevented disturbances occurring on a branch of the distribution network affecting the whole system. Resistive attenuation was used for the subscribers' connections, giving a power of 100mW per programme – a level that was perfectly adequate and was unlikely to cause annoyance to neighbours. Programme selection was carried out by means of a multi-way, two-pole rotary switch. The volume could be regulated by a 25Ω potentiometer in the speaker transformer's secondary winding connections. The system was not designed for maximum quality but for efficiency and simplicity.

Adding TV

When World War II came to an end and the television service was restarted relay operators, as they were called, began to devise methods of carrying television signals on their networks. The attenuation introduced by the audio cables was too high to permit their use for v.h.f. signals, and this in turn made it impossible to use standard off-air receivers. The relay operators distributed the TV signal at lower frequencies, in the band from 3-10MHz, where the attenuation introduced by the cables was tolerable and the losses could be compensated by electronic means. The two major operators at the time, Rediffusion and British Relay, adopted this scheme, though their networks were not identical. Rediffusion allocated one pair of wires per TV channel, with the sound distributed at audio frequency. British Relay managed to add TV to an audio channel, the TV sound being on a 100kHz subcarrier. This latter arrangement gave cable economy, requiring fewer pairs.

The high TV signal attenuation caused by the cables required the use of repeater amplifiers to restore transmission levels whenever these fell to an unusable level. These repeater amplifiers had to be of a high linearity standard to prevent picture distortion and of a high reliability standard to ensure continuity of service. The subscriber terminal unit, as the receiver was called, consisted of an ordinary TV set minus the tuner and vision/sound i.f. section. In place of these latter items a signal-frequency strip amplified the signal selected from the distribution network to a level suitable for detection – the British Relay unit also required a 100kHz sound section.

Multi-channel networks depended on the maintenance of accurate balance in each pair to prevent crosstalk between them. Special cables were developed to aid this aspect of the operation, and latter-day networks are capable of good performance with simple equipment. As a result of the general availability of good off-air signals and the continuing decline in the real cost of TV receivers however many of these h.f. multi-pair networks closed down, the companies concerned generally diverting into television rental. The nature of h.f. multi-pair operation made it feasible only for large networks – the economics mean that large numbers of subscribers are required to make a network viable.

VHF Distribution

With the spread of the television service to more remote parts of the UK in the fifties, and with advances in valve, ferrite and coaxial cable technology, others entered the cable TV field, developing v.h.f. TV signal distribution via cables similar to those used for aerial downleads. V.H.F. operation permitted standard receivers designed for off-air reception to be connected to the system. This had the advantage that the user was freed from the limited choice of receivers on offer from the h.f., multi-pair operators. Subscribers could shop around for their sets, and if they moved house to an uncabled area they could take the set with them. Moreover one coaxial cable could carry several channels, with obvious advantages in terms of cable costs and aesthetics.

Increasing System Capacity

In more recent times satellite distribution of material for cable TV networks has meant that networks require greater channel capacity. Coaxial systems have for some years had greater channel carrying capacity than the programmes available – only in places such as Belgium, with four other countries on its borders, could sufficient channels be found to fill the network capacity. Holiday makers in Ostend will know that BBC and ITV programmes can be seen via the town's cable network.

To increase the channel capacity coaxial operators have gone to the u.h.f. bands, using trunk lines operating at v.h.f. (where cable attenuation is less than at u.h.f.) to distribute the signals for long distances with less need for frequent amplification. This gives better quality pictures at network extremities. Block up-conversion is carried out at the point where subscriber feeds occur, allowing standard u.h.f. receivers to be used. On the Continent, distribution at both v.h.f. and u.h.f. is used to achieve maximum coverage of the TV bands, standard receivers there being capable of v.h.f. and u.h.f. operation. Large networks such as these frequently use twin trunk lines, both operating at v.h.f., with alternate channels on the twin trunks (see Fig. 1). One trunk line is used with up-conversion to feed the subscriber distribution lines, the other feeding v.h.f. directly to them.

To allow more economical use of its existing networks Rediffusion followed British Relay practice, adding TV channels to pairs previously occupied by radio programme audio signals, with the TV sound on a 2MHz subcarrier. This made all the pairs in the system available for radio and TV simultaneously.

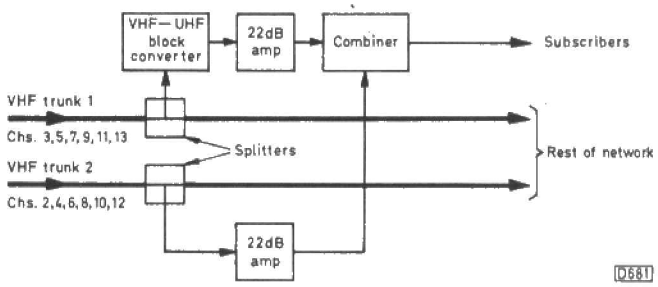

Fig. 1: Use of twin trunk v.h.f. distribution lines.

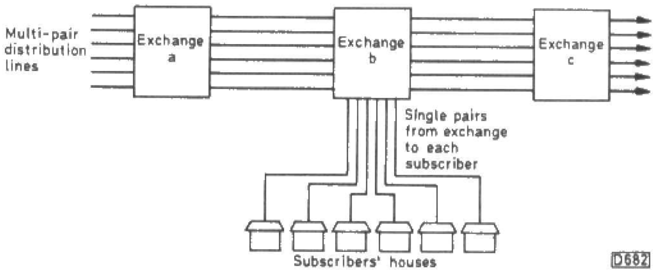
Multi-pair distribution lines
Exchange a
Exchange b
Exchange c
Single pairs from exchange to each subscriber
Subscribers' houses
D682

Fig. 2: Basic Rediffusion "dial-a-programme" arrangement, a method of increasing system capacity.

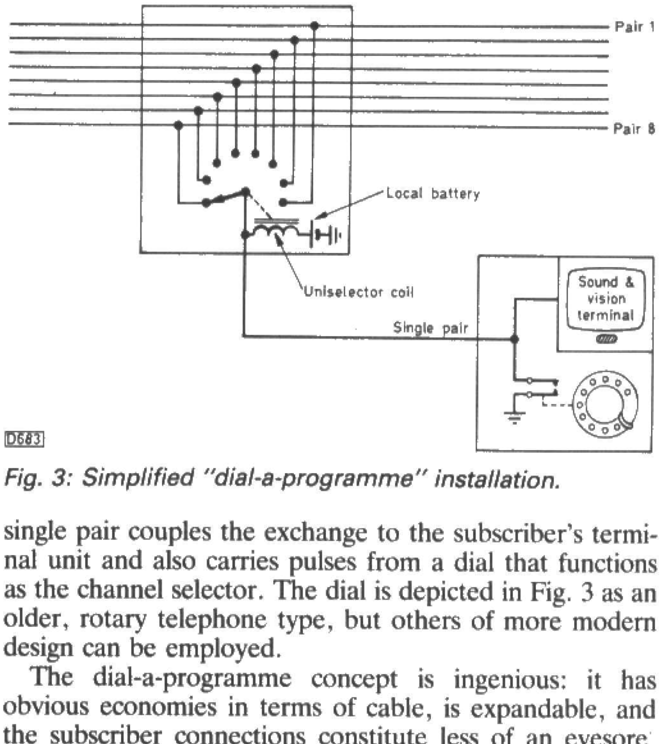

Fig. 3: Simplified "dial-a-programme" installation.

The h.f., multi-pair companies made one further development in an attempt to modernise their systems and increase the channel carrying capacity without having to add extra cables over the entire network. This was the Rediffusion "dial-a-programme" system (see Fig. 2). Prime-quality signals are sent by trunk line to the areas to be served, where they feed distribution lines or spurs which carry the signals through the neighbourhood. Subscribers are connected to the system via exchanges. A single pair couples the exchange to the subscriber's terminal unit and also carries pulses from a dial that functions as the channel selector. The dial is depicted in Fig. 3 as an older, rotary telephone type, but others of more modern design can be employed.

The dial-a-programme concept is ingenious: it has obvious economies in terms of cable, is expandable, and the subscriber connections constitute less of an eyesore. The overall vulnerability of the network to pirating by people with a suitable terminal unit is minimal, and only the siting of each local exchange has to be considered carefully. Nevertheless, in the UK at any rate, the demand for cable TV services of this kind decreases annually. There's a danger of these mighty h.f. networks falling into disuse, as indeed so many already have.

In this first part we've looked at the history of cable TV and the reasons for it. For most readers interest in this will be only academic and it's pointless to go into h.f. system hardware. In part two we'll be looking at the development of v.h.f. and u.h.f. coaxial networks and in this case the kind of hardware in use will be described in some detail. Knowledge of how a coaxial network is planned, designed and commissioned is of benefit to readers who may either use such a system or service receivers connected to one. A good relationship between TV receiver suppliers and cable system operators is essential, and knowledge of each others' problems is a help in achieving this.

Service Bureau

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PHILIPS KT3 TELETEXT

There's a problem with teletext on this set – on all channels. The TV picture is o.k. with no ghosting but there's an intermittent teletext fault that varies between no text on the screen, or a jumble of letters, or a correct teletext display. Applying freezer to the teletext decoder chips and to various parts of the RGB circuitry hasn't pinpointed the cause of the fault.

Your problem is not likely to be due to chip failure in the teletext decoder though the SAA5030 VIP chip could be intermittent. We suggest that you check the tuning very carefully, retuning each station for best performance in the mixed mode. Note if this condition deteriorates when the drawer is pushed back. If so this would indicate that the a.f.c. is off tune. Mistuning can seriously affect teletext reception without showing the slightest impairment of the TV picture.

HITACHI VT9300

The following fault on this machine is intermittent. When play or record is pressed the tape threads and moves but there's no picture or sound on the monitor. After about five seconds the tape returns to the off position. The pause and search controls have no effect when the fault is present, but if the pause control is pressed on and off repeatedly the tape will continue to play – still with no picture or sound. If pause is pressed then released when the machine is working correctly it switches off, leaving the tape loose in the machine.

It's likely that these problems will disappear if you replace the loading belt (across the rear of the deck) and fit a new reel idler assembly of the modified (blue coloured) type.

DECCA 120 CHASSIS

The soft touch channel selector cannot be moved from channel one – even when the button contact is unsoldered. Since this channel cannot be tuned into anything but a very distant transmitter I suspect a supply voltage fault. Changing the SN76705AN chip on the channel selector panel has had no effect.

First check that the 12V supply is present and correct at pins 9 and 10 of the i.c. Then check RM17 (560kΩ). If this is o.k. and you are sure that the replacement chip is in good order change the four resistors, one diode and one capacitor associated with pins 2 and 8 of the chip.

GEC C2110 SERIES

The picture collapsed to a 2in. vertical band then the set went dead. On checking we found that the fusible h.t. resistor was open-circuit and that R617 and C605 in the raster correction circuit had burnt out. Is there anything else that should be checked?

In addition to replacing C605 and R617, replace the raster correction transductor T602 and check the condition and jointing of the associated components R615 and L603. If there's still partial field collapse when this has been done it's likely that the field output transistors will have been damaged.

SONY SLC5

Prerecorded tapes play back perfectly, but when one of the machine's own recordings is played back there's colour noise on the screen – short, fine dark horizontal lines moving into light areas. The sound is unaffected.

The symptoms you mention are typical of worn video heads, which is a common enough thing with these machines now that they are ageing. Prerecorded tapes will play back o.k. until the wear becomes greater because they have only one pass of the faulty heads – self-recorded tapes have two passes. It's unlikely that cleaning the head surfaces will provide any improvement though it's worth trying.

TV SETS AS COMPUTER MONITORS

My Acorn Electron computer works perfectly with a new 20in. Ferguson TV set and with monochrome portables but when used with 14in. Philips or Ferguson colour sets the display tends to wobble and flicker.

Since the computer works happily with some sets the problem is almost certainly due to overloading of the affected sets. It should be overcome by fitting a 6dB (12dB if necessary) in-line coaxial attenuator in the lead between the computer and the set's aerial socket.

PHILIPS G11 CHASSIS WITH REMOTE CONTROL

This set would go to standby when switched on but would go to a station when the remote control handset was operated. Now it goes to standby and operating the remote control unit makes no difference.

The most likely cause of the problem is the set's on/off switch which has a third set of contacts that make momentarily to give power-on reset whenever the set is switched on. If this isn't the cause of the problem, try replacing the two standby transistors T85 (BC148) and T86 (BC158) on the power panel.

FIDELITY ZX2000 CHASSIS

There's an ident problem with this set, i.e. green faces. Changing channels will restore correct colour, suggesting that the ident flip-flop is faulty. I suspect the decoder chip.

This type of ident fault is extremely rare in sets that use a single-chip decoder. We have to agree that the chip is probably faulty since there appear to be no external components that could cause this fault.

FISHER FVH P725 VCR

The fault with this four-head, long-play machine is as follows. SP record and playback are perfect. LP record and playback are o.k. with a new tape, but when LP mode recordings made on top of previously recorded tape (SP recordings) are played back the head switching relay operates at random every few seconds, alternating between LP and SP, though it never stays in the SP mode for more than a split second – it's as if some SP information had not been erased.

Basically, playback speed switching is carried out by IC702 (syscon board) on the basis of information received from the control track head. The probable causes of the fault are: (1) a dirty or misaligned control track head; (2) a vertically misaligned full erase head not seeing the bottom edge of the tape; (3) insufficient drive to the control head during LP mode recording.

TEST CASE

296

Each month we provide an interesting case of TV/video servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.

Field scan problems are not exactly unknown in Philips colour receivers – the G11 chassis in particular had its share of "bright white line" troubles, and we've one or two examples of these sets on our patch with a dark horizontal line etched across the middle of the screen as a result of the set being run with no field deflection.

The Philips set in the spotlight this month was not a G11 however: it was a later one fitted with the KT3 chassis. This has a discrete transistor field timebase with a BD223/BD234 output pair in a complementary-symmetry class B circuit – a reliable and straightforward arrangement. It was on the bench for treatment of a no-go complaint – the cause of the problem was quickly traced to a faulty e.h.t. tripler.

After replacing the tripler the technician examined the newly-restored picture. "Blimey, that tube's been burnt at some time" he said, observing a stationary line across the centre of the screen. In fact it wasn't a burn mark since the narrow line was brighter than the rest of the picture. It seemed unlikely that one of the tube's electrodes was being modulated by a narrow pulse at field rate: the pulse would have had to have been timed at about the middle of the field scan, when there are no such pulses around, are there? Just to be sure, a scope check was carried out at the cathodes, grids and first anode. No spurious pulses were seen.

Plainly something strange was happening in the field timebase. As a first check the field hold preset R8390 was twiddled to see what effect this had. With the picture moving slowly downwards it was seen to be passing through the white line. So an oscillator problem was unlikely. The field output waveform at the "top" of the field scan coils was next examined, using the scope. The sawtooth present looked normal, as did the linearity of the picture itself. The field output stage supply (LT2) at C1588 was reasonably correct at 31·5V; the output stage mid-point voltage (junction R1531/2) was also within tolerance at 17·1V; and the voltage at the collector of the field driver transistor was likewise within a few per cent of being correct. It's true to say that with more care and attention the voltages around the field output stage would have given some solid clues to the cause of the problem. It's also probably true that by magnifying the centre portion of the scope's trace when it was hooked to the output stage mid-point another strong indication of the cause of the fault would have been obtained.

In fact the solution came not from the test equipment but from a Clever Dick who happened to be passing through the workshop at the time. Once he'd satisfied himself that the set used a complementary-symmetry class B output stage he assured those present that he knew what was causing the problem and was reasonably sure as to which individual component was at fault. He was working purely from theory, but as it turned out he was dead right! You'll have his answer next month . . .

ANSWER TO TEST CASE 295 – page 634 last month –

Last month's test case described a classic no colour fault in a modern VCR – a Ferguson 3V42. Despite the frequency of the 4·43MHz voltage-controlled crystal oscillator being correct and proven signal continuity through the playback chroma path there was not a vestige of colour to be seen on the monitor when a colour-bar tape was played back. The fault was also present in the record mode, since a tape recorded by the machine produced no coherent colour when played back via another machine.

The oscilloscope and service manual had provided a fairly full picture of what was happening inside the ailing machine, in that the chroma signal was present right up to the playback colour killer – and occasionally beyond it. It was disordered however, in such a way that the auto-killer circuits in the VCR and the TV set wouldn't recognise it. On further thought the likelihood was that the subcarrier and burst were of incorrect phase. And so indeed it proved to be.

The phase of the chroma signal is shifted during both record and playback by the phase-rotation stage in the colour-under circuitry. This is buried deep inside IC401. To do its job this stage requires two pulse feeds, a 25Hz flip-flop signal and a line-rate pulse. It was these items that our technician had not thought to check. We discovered that the line pulse (referred to as "sync" in the circuit diagram) at pin 8 of IC401 was missing due to a bad contact at a crimp terminating the J1 cross-board lead adjacent to Q27.

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